REPORT RESUMES

ED 013 953 VT 003 171

SMALL CRAFT OPERATION AND NAVIGATION.

LOUISIANA ST. DEPT. OF EDUC., BATON ROUGE

LOUISIANA ST. VOCAT. CURRICULUM DEV. AND RES. CTR.

PUB DATE 60

EDRS PRICE MF-$0.50 HC NOT AVAILABLE FROM EDRS. 105P.

DESCRIPTORS- *TEXTBOOKS, *TRADE AND INDUSTRIAL EDUCATION, *BOATMEN, *NAVIGATION, ADULT VOCATIONAL EDUCATION, PROBLEM SOLVING, REFERENCE MATERIALS, ASSIGNMENTS,

THIS REFERENCE TEXTBOOK WAS PREPARED FOR USE IN THE FIRST PART OF A TWO-PART COURSE IN MARINE NAVIGATION AND SMALL CRAFT OPERATION ON INLAND AND INTERNATIONAL WATERS. THE MATERIAL WAS DEVELOPED BY AN INDIVIDUAL AUTHOR FOR USE IN TRADE SCHOOL PREPARATORY AND EXTENSION CLASSES FOR MALE ADULTS WHO PLAN TO OPERATE BOATS. IT IS MAINLY CONCERNED WITH CHARTS, COMPASSES, AND OTHER INSTRUMENTS OF NAVIGATION AND THEIR USE IN FINDING A VESSEL'S POSITION. THE OPERATIONAL ILLUSTRATIONS USED WERE TAKEN FROM SITUATIONS WHICH OCCUR IN SMALL CRAFT OPERATION IN THE GULF OF MEXICO. THE AREAS OF INSTRUCTION ARE RULES AND REGULATIONS, AIDS TO NAVIGATION, AND THE MARINE COMPASS AND PILOTING. EACH AREA IS DIVIDED INTO LESSONS WHICH CONTAIN TECHNICAL INFORMATION, LINE-DRAWING ILLUSTRATIONS, AND PROBLEM SOLVING EXERCISES. THIS MATERIAL WAS DESIGNED FOR PERSONS WITH SOME SEA EXPERIENCE AS WELL AS FOR THOSE JUST STARTING THE STUDY OF NAVIGATION. THE TEACHER MUST BE SKILLED IN THE OPERATION AND NAVIGATION OF BOATS. THE APPENDIXES ARE COMMON NAUTICAL TERMS, EQUIPMENT REQUIRED ON MOTOR BOATS, HOW SAFE A SKIPPER ARE YOU, AND INTRODUCTION TO FIRST AID. THIS DOCUMENT IS AVAILABLE IN SINGLE COPY ONLY FOR $2.00 FROM VOCATIONAL CURRICULUM DEVELOPMENT AND RESEARCH CENTER, P.O. BOX 657, NATCHITOCHES, LOUISIANA 71457. AN INSTRUCTOR'S GUIDE (VT 003 160) IS ALSO AVAILABLE FOR $2.00 FROM THE SAME SOURCE. (HC)

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SMALL CRAFT OPERATION and NAVIGATION

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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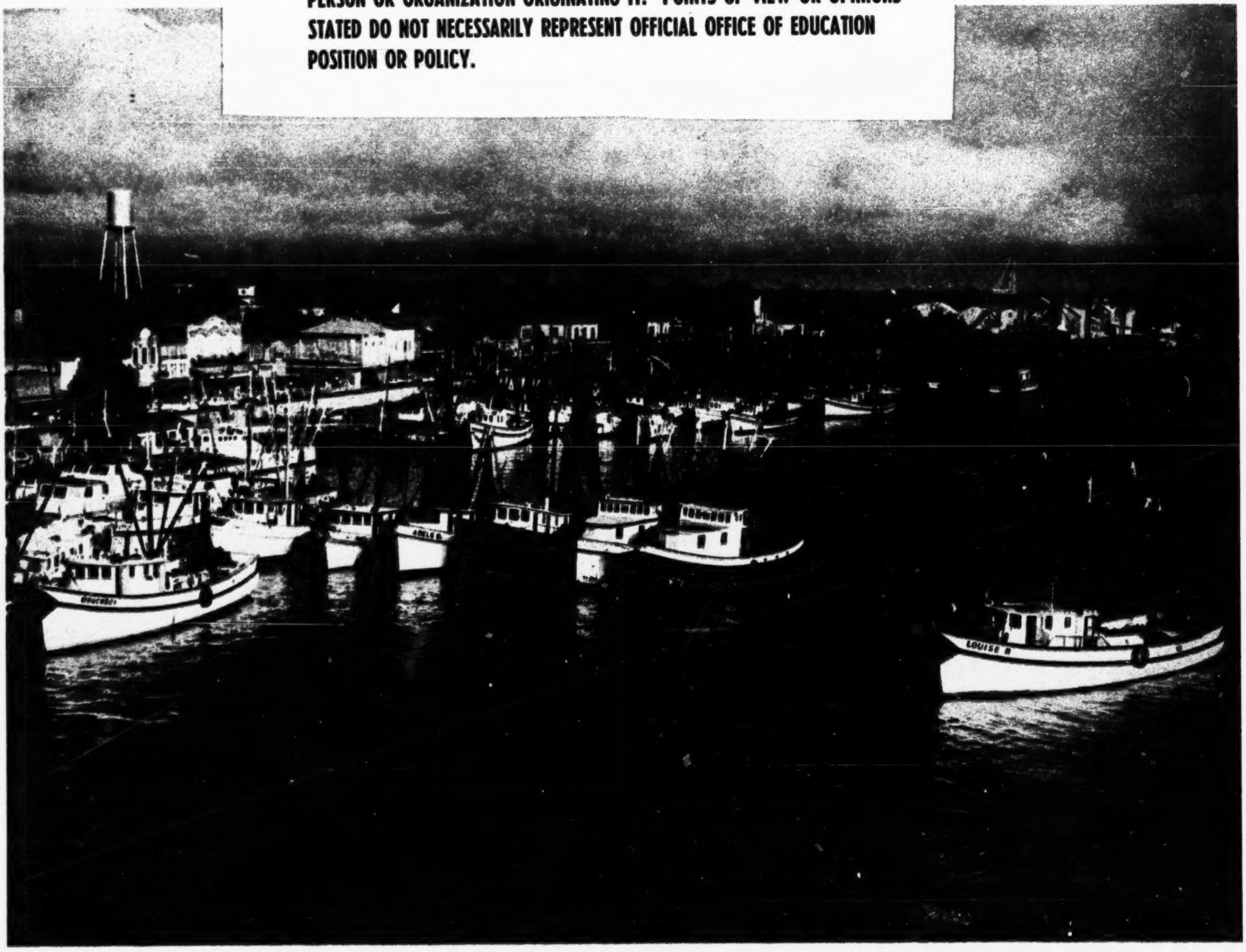

Issued by

State Superintendent Of Education

State of Louisiana

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VT003171

TABLE OF CONTENTS

UNIT I

SMALL CRAFT OPERATION AND NAVIGATION

Page

Introduction- 1

Part I - Rules and Regulations

Lesson 1 - Equipment Required by Regulations - - - 3

Lesson 2 - Classes of Vessels - - - - - - - - - - - 9

Lessons 3 & 4 - Rules of the Road - - - - - - - - - 24

Lesson 5 - Recommended Equipment to be Carried on Small Craft- - - - - - - - - - - - - - 31

Part II - Aids to Navigation

Lesson 6 - Buoys and Markers - - - - - - - - - - - - 35

Lesson 7 - Lights - - - - - - - - - - - - - - - - - 41

Lesson 8 - Charts - - - - - - - - - - - - - - - - - 46

Lesson 9 - The Use of Charts in Piloting - - - - - 51

Lesson 10 - Navigation in Fog and Other Conditions or Reduced Visibility- - - - - - - - - 60

Part III - The Marine Compass and Piloting

Lesson 11 - Historical Background and Construction - - - - - - - - - - - - - - - 66

Lesson 12 - Magnetism - - - - - - - - - - - - - - - 72

Lesson 13 - Compass Error - - - - - - - - - - - - - 76

Appendix A - Common Nautical Terms - - - - - - - - - - - 92

Appendix B - Equipment Required on Motor Boats - - - - 95

Appendix C - How Safe a Skipper are You? - - - - - - - 96

Appendix D - Introduction to First Aid - For Lessons 1, 2, and 3 - - - - - - - - - - - - 97

INTRODUCTION

This is a course in Marine Navigation and Operation prepared especially for Louisiana's commercial fisherman and small craft operators. The illustrations used are taken from situations which occur in small craft operating in the Gulf of Mexico.

The material of this course includes the information covered in the requirements for licensing of small craft operators by the Coast Guard and will serve as good preparation for Coast Guard examination. The study will be valuable to those who have had some sea experience as well as the person who is just starting the study of navigation.

The course begins with the regulations that govern small craft operation and a study of the rules of the road for inland and international waters. The student navigator must become familiar not only with the tools of his trade but also their proper use.

The main concern of this course is with charts and compasses and other instruments of navigation and their use in finding a vessel's position.

This course is divided into two parts. This is Unit One which covers (1) Regulations, (2) Navigational Equipment, (3) The Marine Compass and Piloting. Unit Two is concerned with the practice of offshore navigation including an introduction to celestial navigation.

The student navigator should understand that his profession is really learned at sea and not in the classroom. His real classroom is the water. This course is his preparation for the life-time study of a profession that has interested men for thousands of years.

PART I RULES AND REGULATIONS

LESSON 1

EQUIPMENT REQUIRED BY REGULATIONS

When we look at the equipment of a well found vessel we see fire fighting equipment is considered to be most important (See table appendix "B"). This is because fire is the greatest danger to the sailor. The best way to fight a fire is to prevent it or to fight it before it starts. The equipment regulations consider fire prevention by requiring vents and flame arrestors. There are several rules of good practice in fire prevention which we will take up at this point. These rules give the operator of a vessel some definite things he can do to prevent fire.

1. Inspect frequently all fuel lines for leaks which may allow an accumulation of fumes in bilges or other places where an explosion can occur. A spark from an engine or an electric switch sometimes ignites such fumes.

2. Install and frequently inspect flame arrestors on gasoline engines as required by the regulations. Only an approved type should be used.

3. Inspect frequently all fuel tank vents to be sure that they are clear and are providing proper ventilation to the tanks.

4. Inspect all electrical grounding of fuel tanks and other equipment in the vicinity of fuel and engine spaces. It is important that all metal as well as electrical equipment be grounded so that static sparks and arcing can be eliminated as a fire hazard.

5. As a standard procedure, vent the engine and bilge spaces using power blowers or natural vents or both for at least five (5) minutes prior to starting engines or motors to get rid of fumes which may have accumulated in these spaces. Refueling time is an especially dangerous operation as far as fire is concerned. Care must be taken to vent compartments during and after fueling to prevent the accumulation of fumes.

6. Any spilled fuel must be flushed down before getting underway from the fuel dock. In this same connection it must be remembered that a clean ship is a safe ship. Rags and other combustibles must not be allowed to accumulate. Compartments where gear is stowed must be frequently inspected to be sure that fire hazards are not present.

Fire prevention must be practiced and conducted before the fire starts. Once ignition takes place we can only fight the fire; it is too late for prevention.

Fire fighting equipment is probably the most important thing aboard a vessel because, as we said before, fire is the greatest danger to the sailor. Fire extinguishers must be of the approved type and number and must be maintained and inspected to insure their usefulness. They must be kept where they can be reached quickly when needed and where they will not be cut off by a fire. Built-in fire fighting equipment operated by a remote control is excellent because it allows the fire to be fought with a minimum danger of personal injury.

It is important that the boat operator understand that water must never be used to fight a gasoline, oil, or electrical fire. Water will only spread the flames in the case of a gasoline fire and will create short circuits in electrical installations, especially if salt water is used.

Carbon dioxide (CO_2) or foam should always be used on fires which need to be fought by smothering. Foam may be used on a gasoline fire. Water fights fire by cooling--not by smothering.

Figure 1 shows several items of equipment besides the fire extinguishers. These other items of equipment include life jackets which must be of the approved type (Kapok or Cork). The seat cushion type life preserver is not standard equipment as far as the regulations are concerned and may be carried as optional equipment. Life jackets must be frequently inspected to be sure that they are serviceable and stowed where they are readily accessible.

Probably the next most important gear a vessel carries is its signaling equipment. This includes fixtures such as running lights and other items such as ships bell, fog horn, whistle and signal lights. These items of equipment are needed in order that the vessel may make her presence and identity known to other ships. The characteristics and position of running lights as well as fog signals will be taken up in detail later.

Some items of equipment are usually found on a proper vessel which are not actually required by the regulations

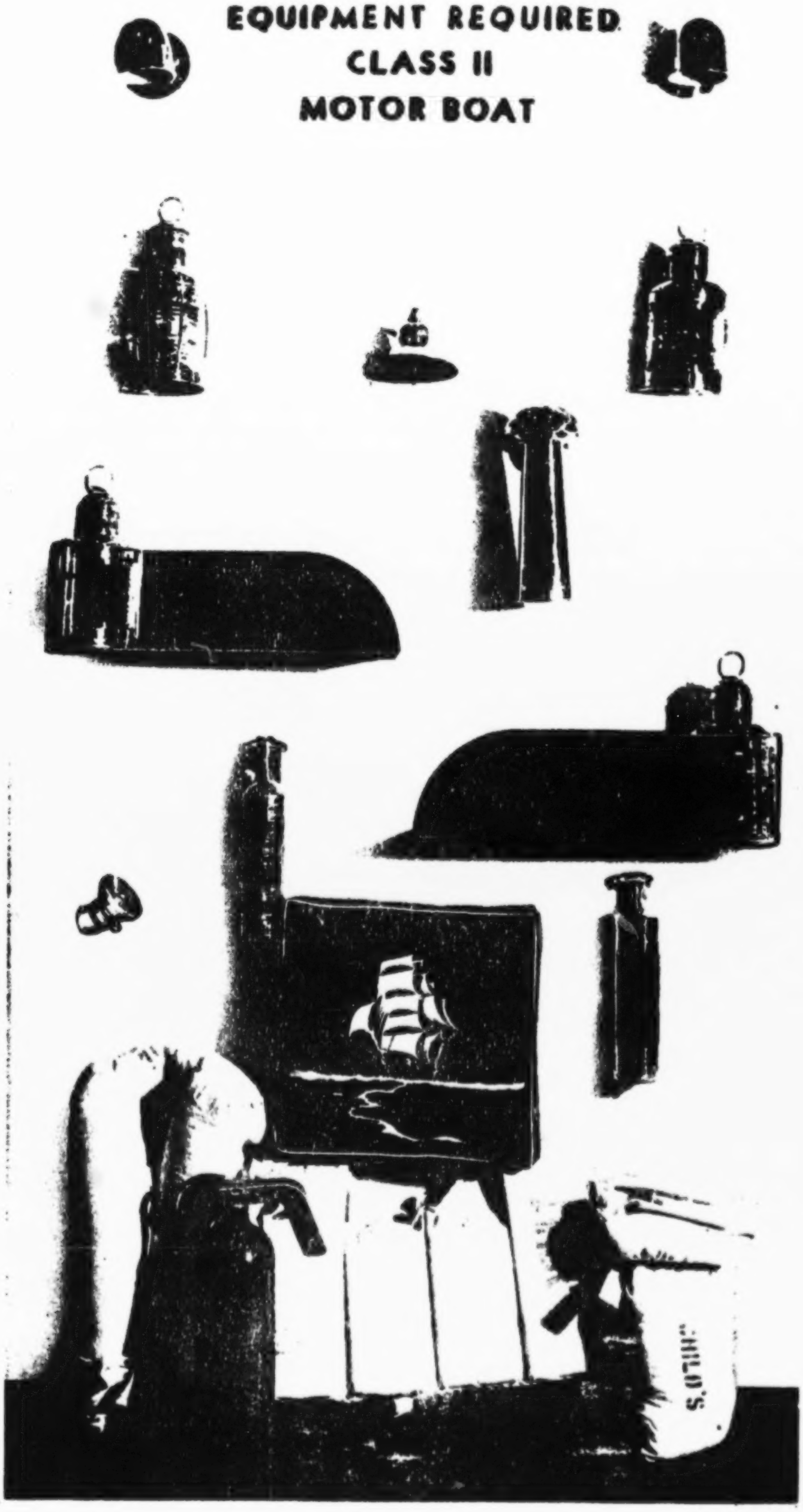


Fig. 1

but are highly recommended by sailors generally. These include first aid supplies, tools for minor repairs and damage, flares, spare equipment and parts for engines and communication gear such as radio and ship-shore telephone. Also of some importance is proper ground tackle and deck gear.

It is also recommended that the operator supply himself with whatever navigational equipment he may require, considering the type of operation in which he is engaged. This may range all the way from the simplest magnetic compass to the most complete electronics navigation gear.

ASSIGNMENTS: LESSON 1

I. Make a check-off sheet for your own boat to be used in maintaining her in a condition of preparedness for Coast Guard inspection.

   a. List all equipment required by the regulations for a boat of her class and provide space for filling in date of inspection.

   b. Call this check off list "owner's monthly inspection report".

II. Conduct an informal inspection of a boat and write up a report to present to the class at the next meeting.

   a. Include in this report:

      1. Date and place of inspection
      2. Name of boat and registry number
      3. Name of owner and/or operator
      4. An itemized list of equipment required by the regulations

   b. Describe general condition of the boat you inspected

III. Be prepared to report to the class on a marine accident of which you have first hand knowledge.

   a. Include in this report:

      1. Time and place of accident
      2. Events leading up to accident
      3. Extent of damage and/or injury

   b. How could accident have been avoided

IV. Make a list of the causes of accidents at sea starting your list with poor seamenship and going into equipment failures.

LESSON 2

CLASSES OF VESSELS

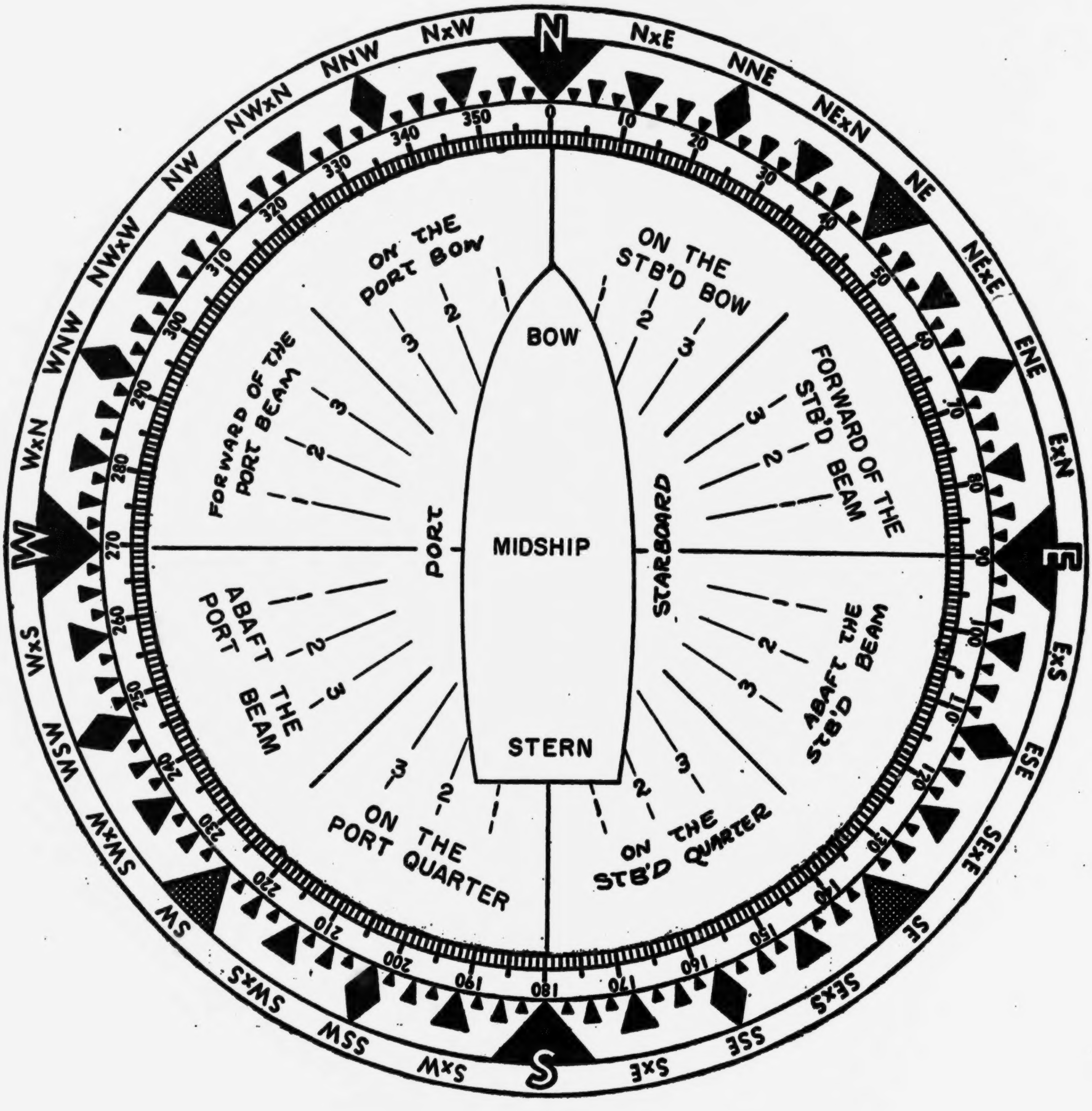
In order to understand the lights required on different classes of vessels it is necessary to first consider relative bearings and sectors of visibility of these lights. An examination of the compass card and bearing circle as shown in Figure 2 will be helpful at this point.

The navigator is always interested in direction. He needs to know which course he is steering, what the bearing of an object is from his ship and the position of his ship with respect to other ships or landmarks. Courses and bearings are usually taken from North and may be counted in degrees or in points of the compass.

Relative position or bearings are measured from the ships bow and are usually told off in points much like the points of the compass.

Figure 2 shows the relationship of compass points, relative bearings and degrees of azimuth measured clockwise from true north. An examination of this diagram shows that the compass points and relative bearing points both number thirty-two (32) and that the relative bearing points take their names from the parts of the ship namely bow, stern, starboard side, and port side.

When facing the bow the starboard side is on the right hand and the starboard beam is beyond the right hand. A light seen off the right hand (or the starboard side of the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160
170
180
190
200
210
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270
280
290
300
310
320
330
340
350
ON THE PORT BOW
ON THE STB'D BOW
FORWARD OF THE PORT BEAM
FORWARD OF THE STB'D BEAM
ABAFT THE PORT BEAM
ABAFT THE STB'D BEAM
ON THE PORT QUARTER
ON THE STB'D QUARTER
BOW
PORT
MIDSHIP
STARBOARD
STERN
2
3

Fig. 2

vessel) is said to be "to starboard" and one to the left is said to be "to port." The direction directly perpendicular to the ship's keel is called by the name "beam" because the vessel's deck beams lie in that direction, and is designated as "starboard beam" or "port beam" depending upon which side it lies.

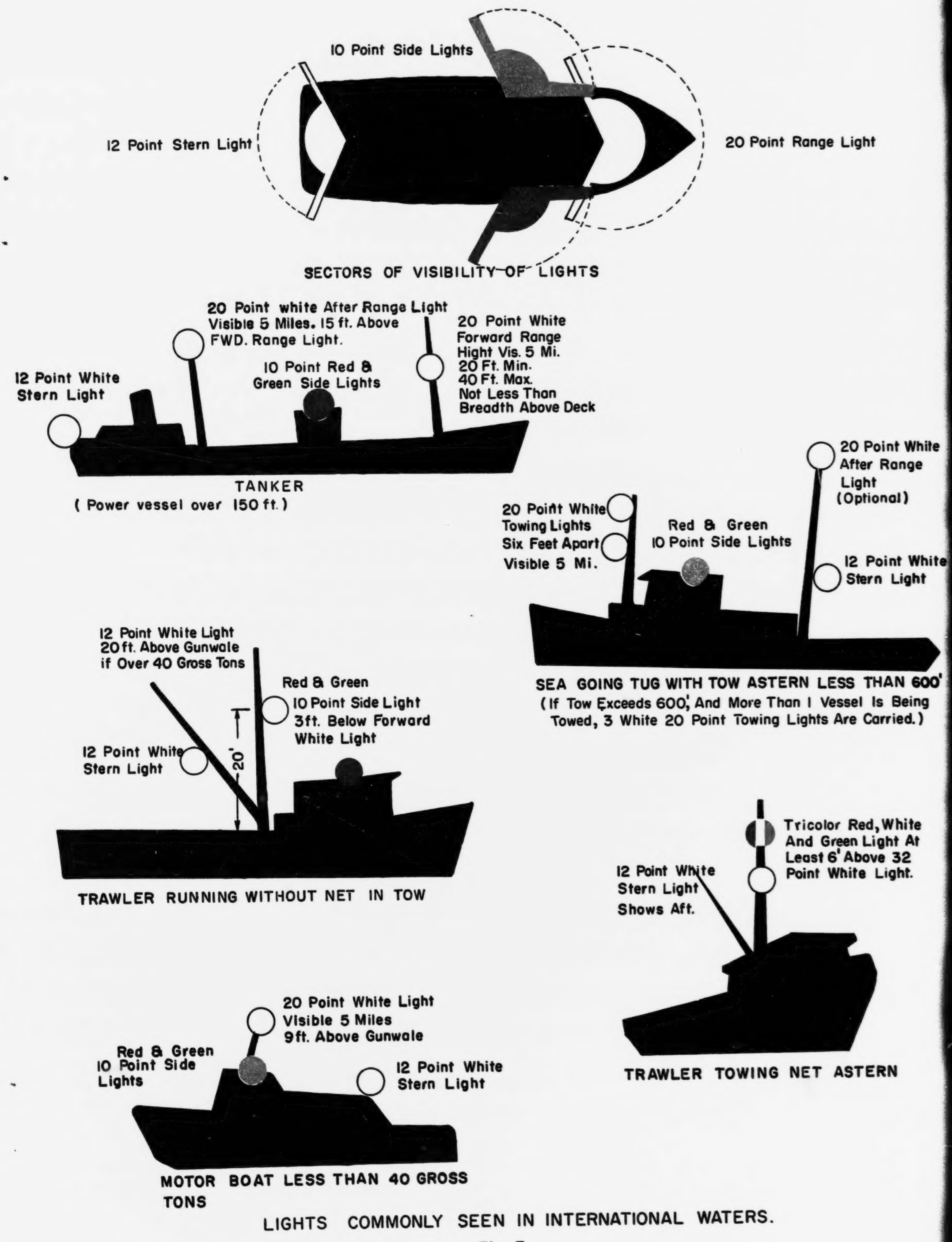
From starboard bow to port bow is said to be the bow sector. From starboard bow to starboard quarter is called the starboard beam sector. The quarter sector is that sector which lies between the starboard quarter and port quarter. These four sectors are divided into the 32 points already mentioned. Examining figure 2 we see them as follows: from ahead to abeam and from astern to abeam (one point on the starboard bow, 2 points on the starboard bow, 3 points on the starboard bow, broad on the starboard bow, 3 points forward of the starboard beam, 2 points forward of the starboard and so on).

The 32 compass points we see take their names from the four cardinal parts; North, South, East and West. The expression "boxing the compass" is the term applied to naming the 32 points of the compass starting with North and moving around in a clockwise direction. The seaman identifies compass points with relative bearing points and with degrees of azimuth (also shown in figure 2) he knows that the 360° of azimuth divided by the 32 compass points equal 11.25° or eleven and one fourth degrees to the compass point. Boxing the compass is a basic skill of the sailor.

Now that we understand relative bearings we are ready to study navigation lights. These lights tell other ships our position and by them we are able to know how another vessel is headed and so we can tell if a collision might occur.

Figure 3 shows the sectors of visibility of lights. We see that the red and green side lights are visible through ten points--that is: from dead ahead to two (2) points abaft the beam on either side and the stern light is always a 12 point light while the masthead light and range light may be either 20 or 32 point lights depending upon the type vessel and the operating circumstances.

Inland rules apply generally inside a line marked by the position of seabuoys along a coast as illustrated in figure 4. Figures 5, 6, 7 and 8 show cases of vessels operating under inland rules and the lights they are required to carry.


10 Point Side Lights
12 Point Stern Light
20 Point Range Light
SECTORS OF VISIBILITY OF LIGHTS
12 Point White Stern Light
20 Point white After Range Light Visible 5 Miles. 15 ft. Above FWD. Range Light.
10 Point Red & Green Side Lights
20 Point White Forward Range Hight Vis. 5 Mi. 20 Ft. Min. 40 Ft. Max. Not Less Than Breadth Above Deck
TANKER
(Power vessel over 150 ft.)
20 Point White After Range Light (Optional)
20 Point White Towing Lights Six Feet Apart Visible 5 Mi.
Red & Green 10 Point Side Lights
12 Point White Stern Light
SEA GOING TUG WITH TOW ASTERN LESS THAN 600'
(If Tow Exceeds 600', And More Than 1 Vessel Is Being Towed, 3 White 20 Point Towing Lights Are Carried.)
12 Point White Light 20 ft. Above Gunwale if Over 40 Gross Tons
Red & Green 10 Point Side Light 3ft. Below Forward White Light
12 Point White Stern Light
20'
TRAWLER RUNNING WITHOUT NET IN TOW
Tricolor Red, White And Green Light At Least 6' Above 32 Point White Light.
12 Point White Stern Light Shows Aft.
TRAWLER TOWING NET ASTERN
20 Point White Light Visible 5 Miles 9ft. Above Gunwale
Red & Green 10 Point Side Lights
12 Point White Stern Light
MOTOR BOAT LESS THAN 40 GROSS TONS

LIGHTS COMMONLY SEEN IN INTERNATIONAL WATERS.

Fig. 3

We see in figure 4 the boundary line between inland and international waters. This line generally runs through the outermost chains of buoys along the coast.

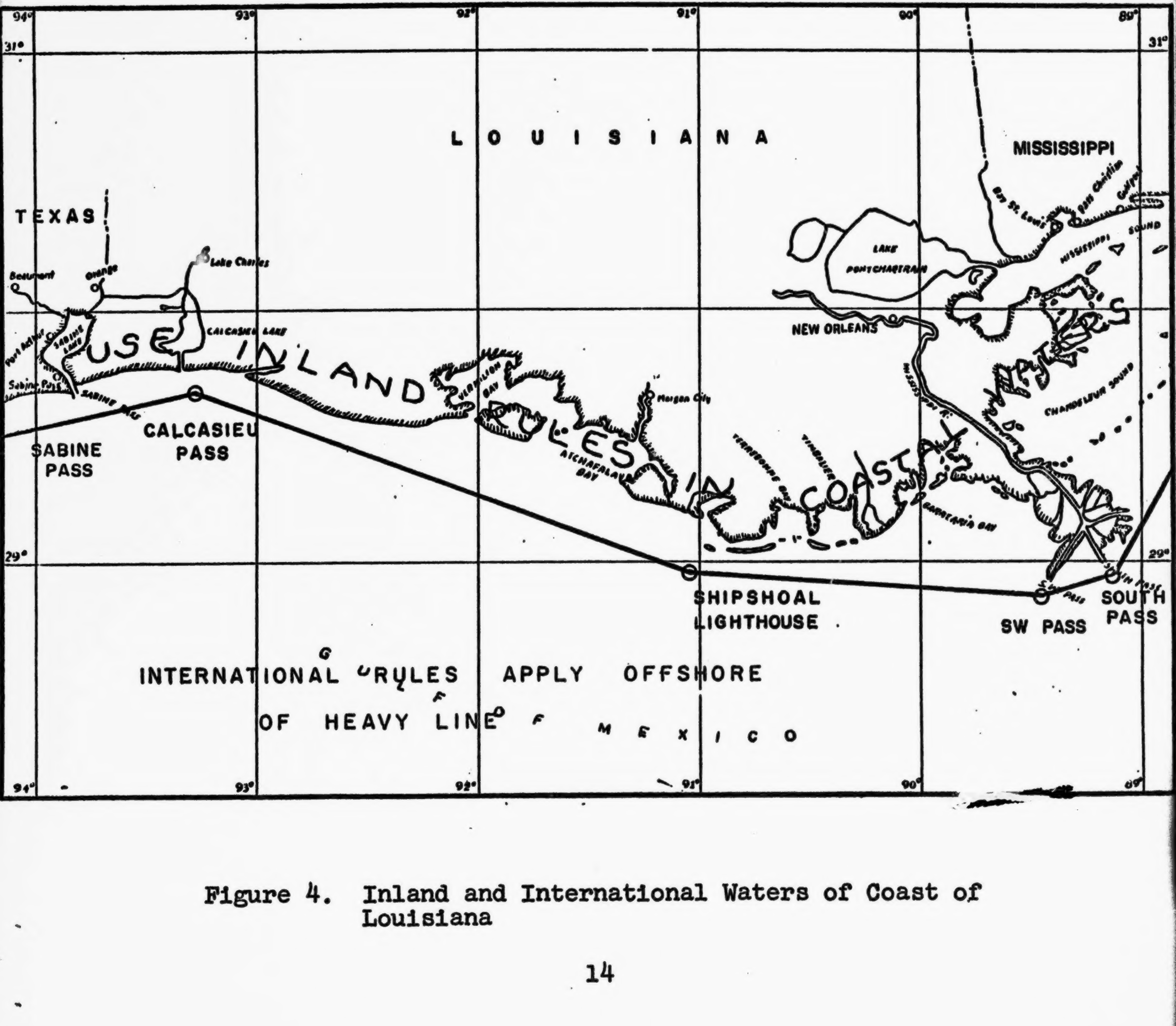
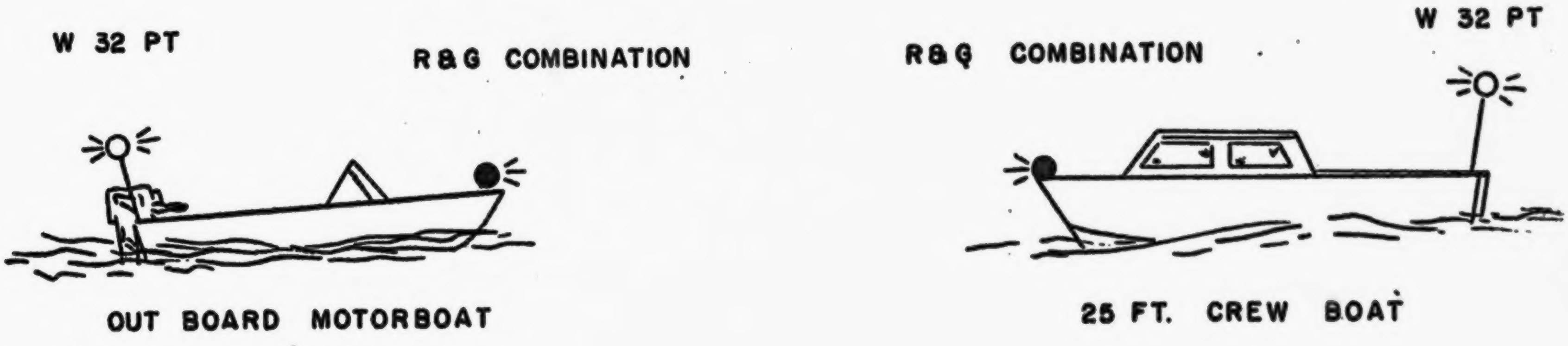
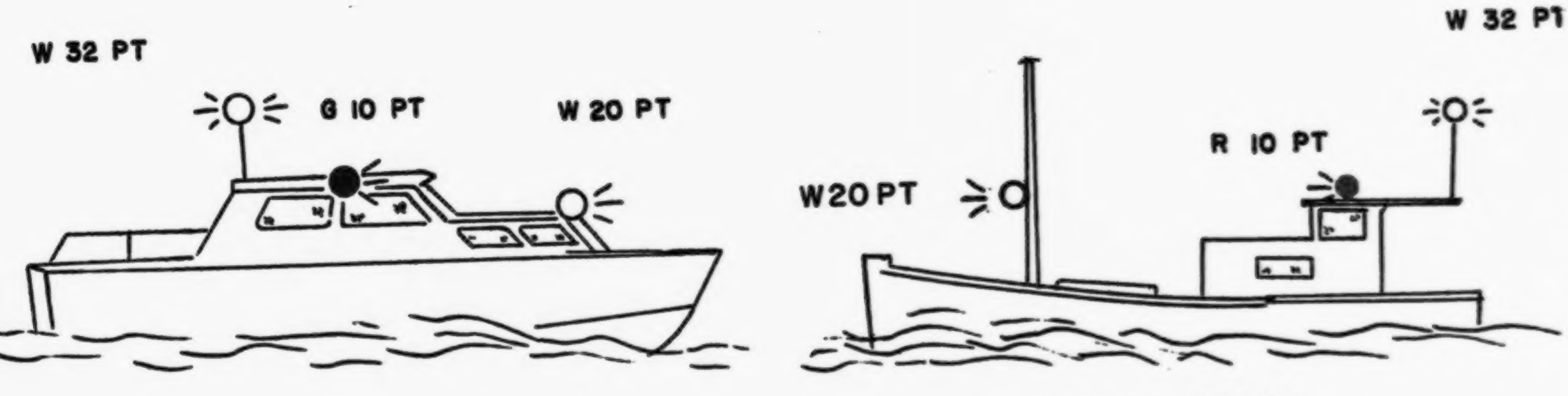


Figure 4. Inland and International Waters of Coast of Louisiana

Figure 5 shows lights required under inland rules on motor boats. First we see that the class 1 as well as class A boats, that is less than 26 feet in length, carry forward a red and green combination light and aft a white 32 point light that the class II motor boat, that is from 26 to 40 feet, carries in addition to the red and green side lights, which are always 10 point lights, 2 white lights, one forward being a 20 point light, and one aft which is a 32 point light. The class III motor boat which is 40 to 65 feet in length carries these same lights; that is red and green 10 point lights to port and starboard and the white 20 point light forward the white 32 point light aft.



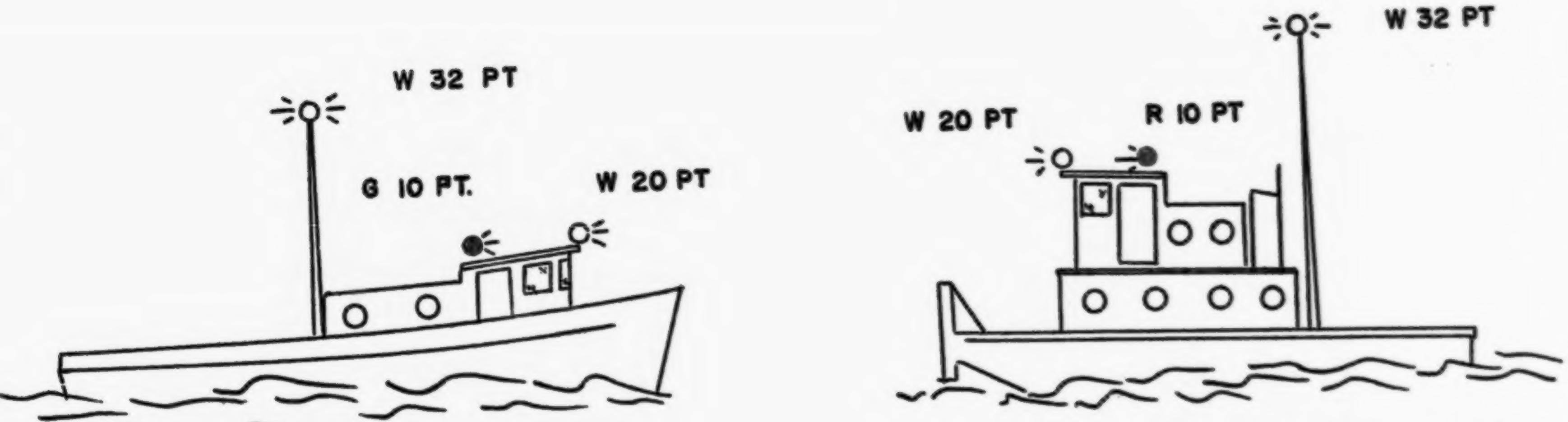
Class A and Class 1 Motorboats
(Less Than 26 Feet)



36 FT. CREWBOAT

38 FT. LUGGER

Class 2 Motorboats (26 to 40 Feet)



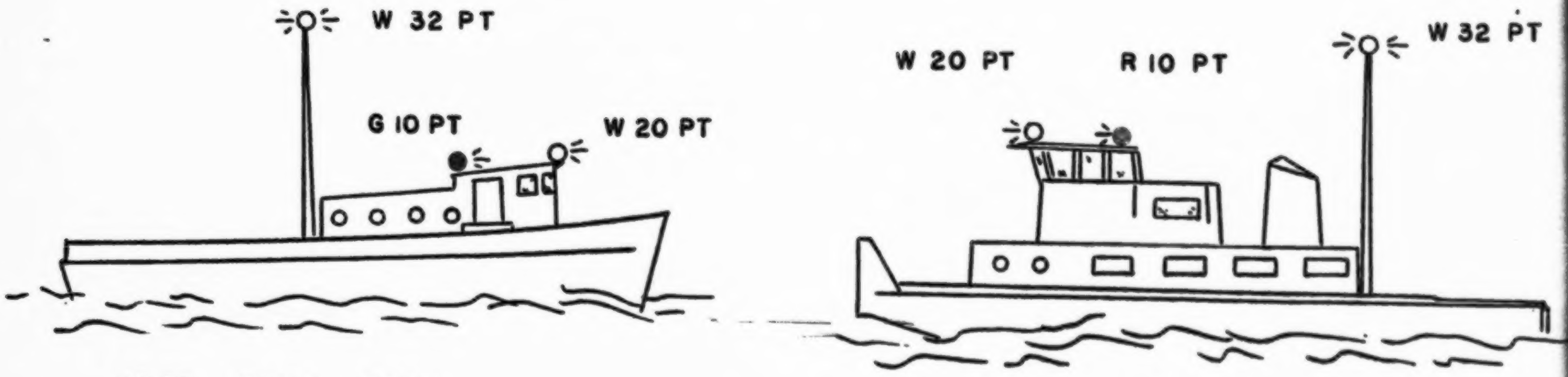
63 FT. WORKBOAT

50 FT. PUSHER TUG (Without Tow)

Class 3 Motorboats (40 to 65 Feet)

Figure 5. Lights Required on Motorboats in Inland Waters

Figure 6 shows the lights required by motor vessels in inland waters. We see the 68 - foot fishing boat underway and the tow boat both carrying the same lights. Not the same range of visibility etc.

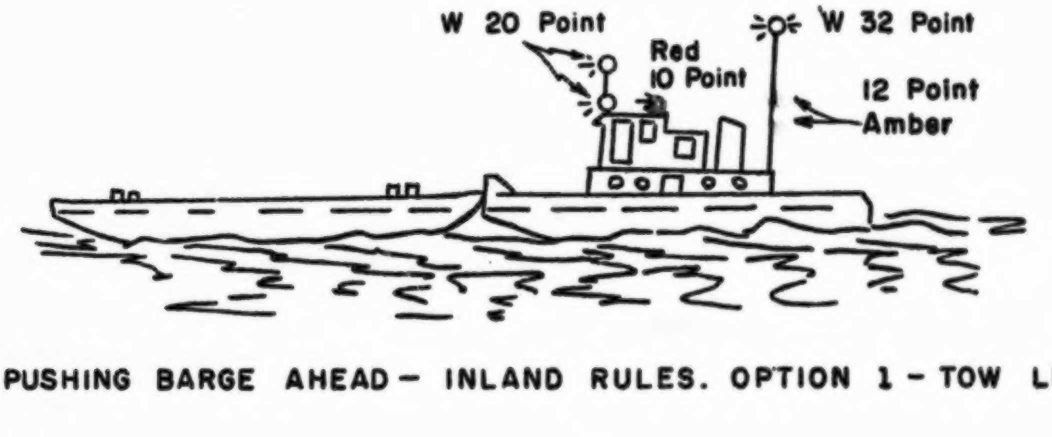


68 FT. WORK BOAT

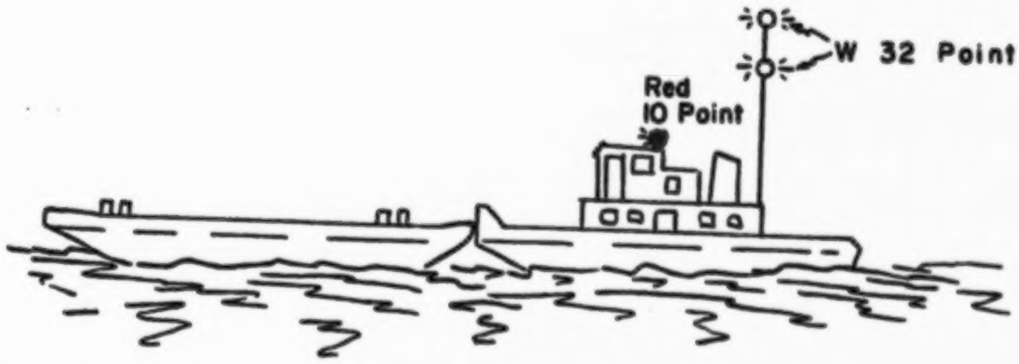
70 FT. TOW BOAT (Without Tow)

Figure 6. Lights for Motor Vessels in Inland Waters

In Figure 7 we have the tow boat under inland rules. We see the tug pushing a barge ahead carrying two lights, either two 20 point lights one above the other or two 32 point lights one above the other. These lights if they are 20 point lights must be carried forward and if they are 32 point lights must be carried aft. Either set of lights may be carried, either the 20 point lights forward or the 32 point lights aft. If the 20 point lights are carried forward, and the vessel is pushing the barge, two 12 point amber lights are carried near the stern.



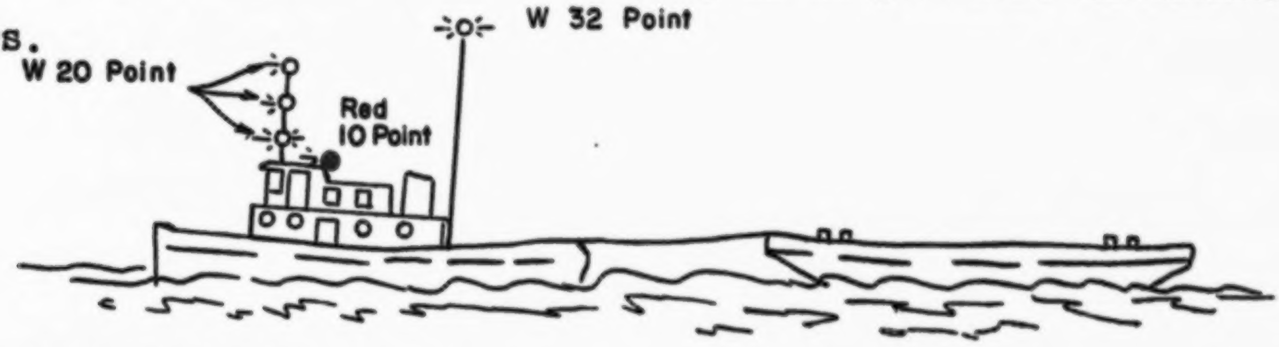
TUG PUSHING BARGE AHEAD – INLAND RULES. OPTION 1 – TOW LIGHTS FORWARD.



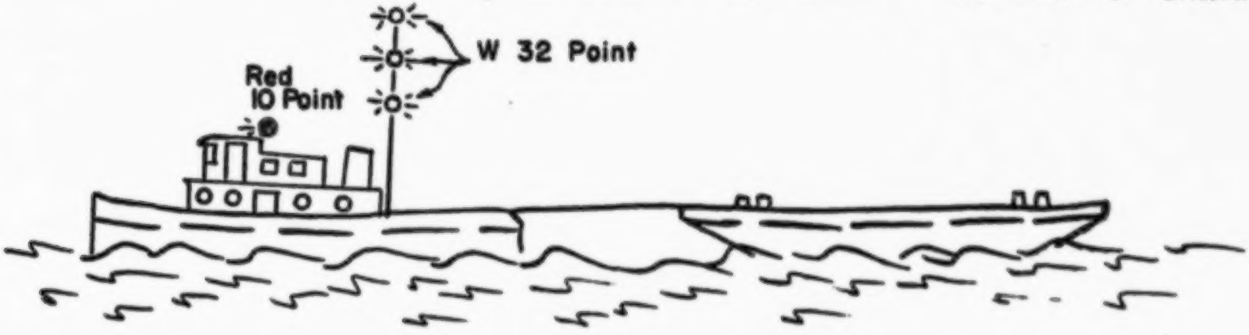
TUG PUSHING BARGE AHEAD - INLAND RULES. OPTION 2 - TOW LIGHTS AFT.

Figure 7

In Figure 8 we see a tug towing a barge under the inland rules and we see that this boat carries three lights one above the other, if they are carried forward they must be 20 point lights, if they are carried aft they must be 32 point lights. Now this tug boat if it were operating under international rules would carry the two lights if the tow was less than 600 feet in length and three lights when the tow is more than 600 feet in length. The reason for the difference is that a tug in the open sea will never be pushing as is possible in inland waters.



TUG TOWING BARGE ON HAWSER - INLAND RULES - OPTION 1 - TOW LIGHTS FORWARD.



TUG TOWING BARGE ON HAWSER - INLAND RULES - OPTION 2- TOW LIGHTS AFT.
Figure 8. Lights for Tug Boats
in Inland Waters

In Figure 9, we see the trawler, this trawler is dragging a net under international rules. It is carrying no side lights, a 12 point stern light, a 32 point white light, and above that a three colored light that shows green to starboard, red to port and white forward

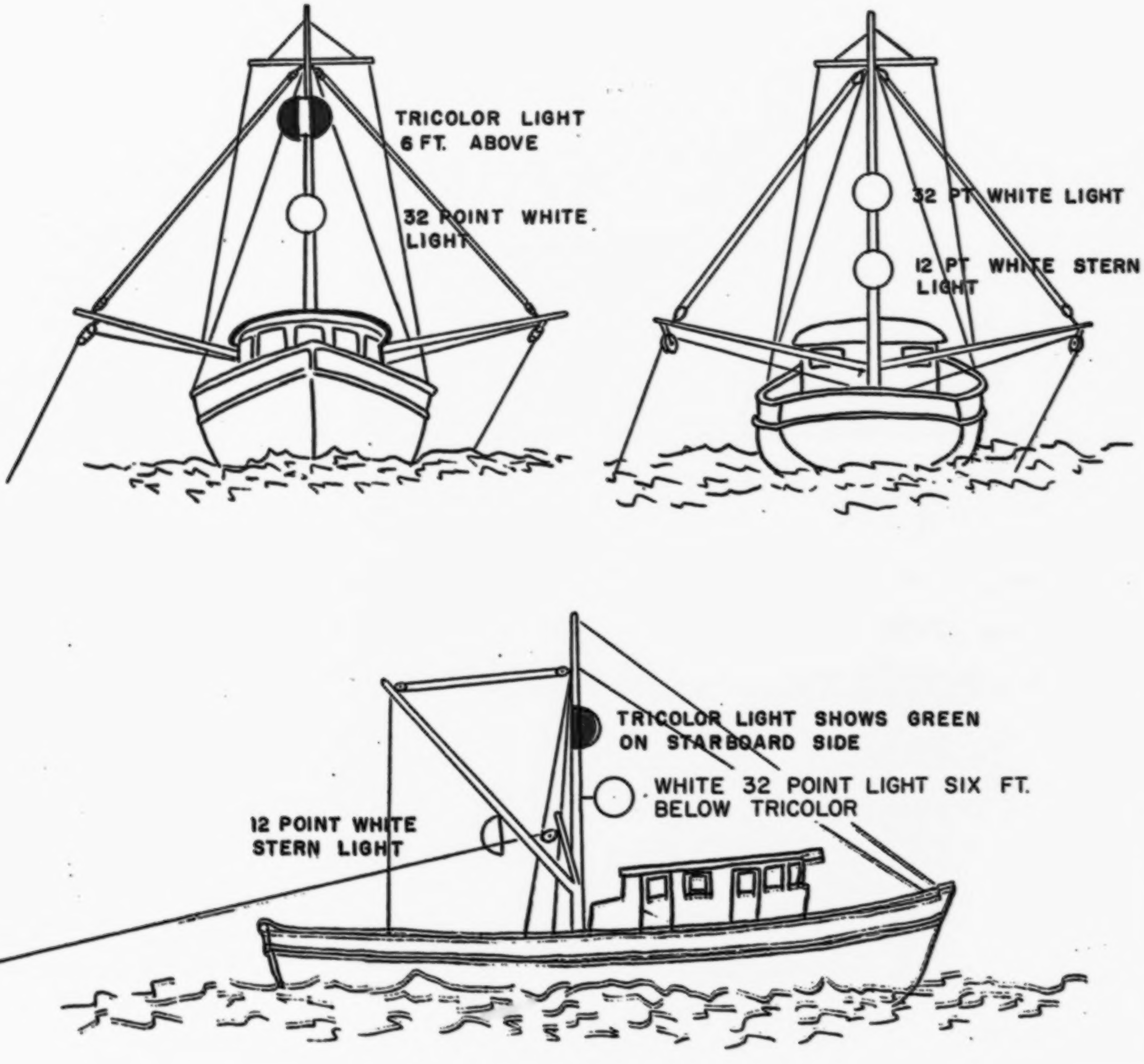

TRICOLOR LIGHT
6 FT. ABOVE
32 POINT WHITE LIGHT
32 PT WHITE LIGHT
12 PT WHITE STERN LIGHT
TRICOLOR LIGHT SHOWS GREEN ON STARBOARD SIDE
WHITE 32 POINT LIGHT SIX FT. BELOW TRICOLOR
12 POINT WHITE STERN LIGHT

Figure 9. Trawler Dragging Net Astern, International Rules

In Figure 10, we see the trawler running without the nets, there she carries the lights of her class, the 20 point white light at the mast, the 12 point stern light, and the 10 point side lights.

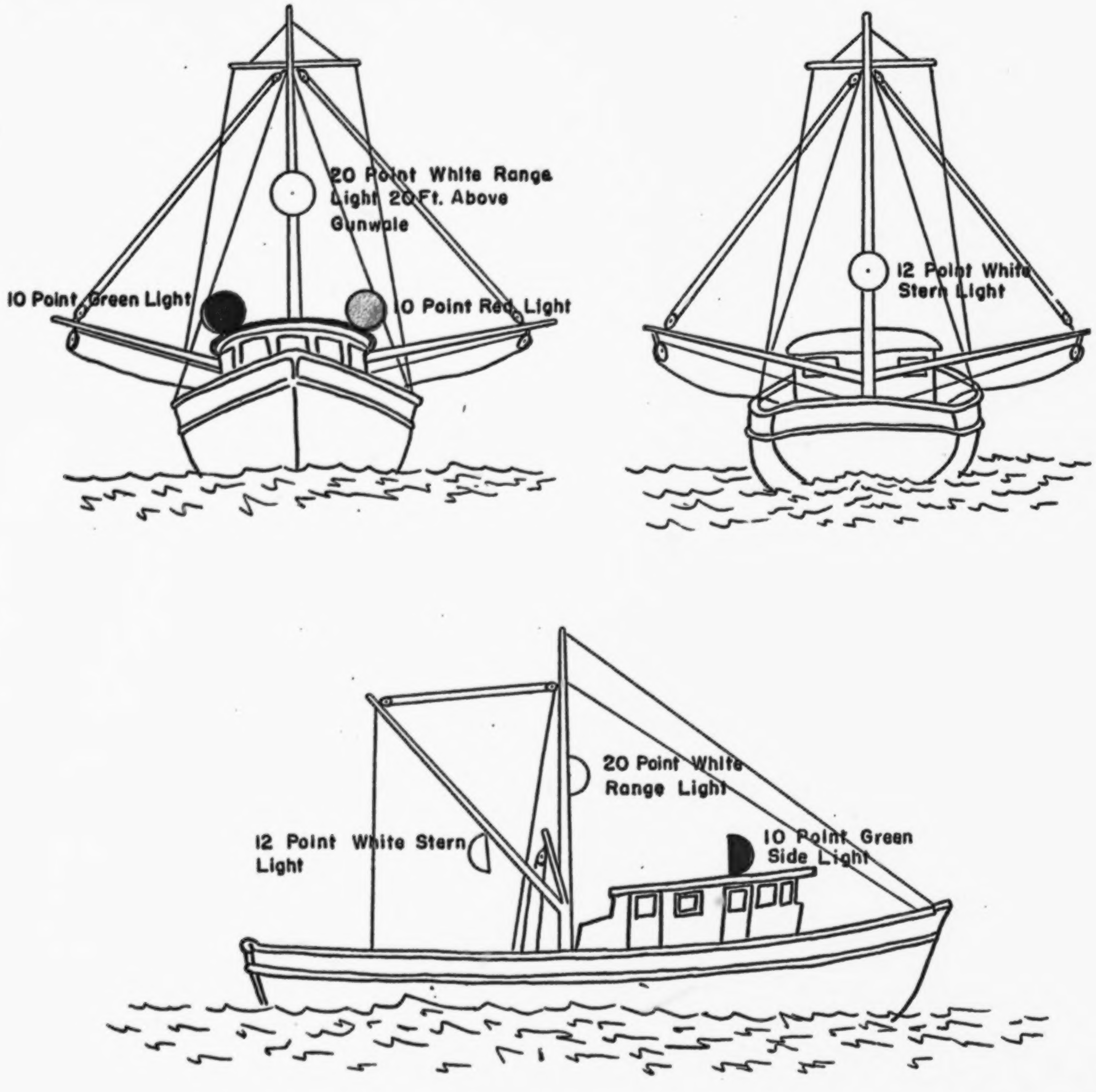
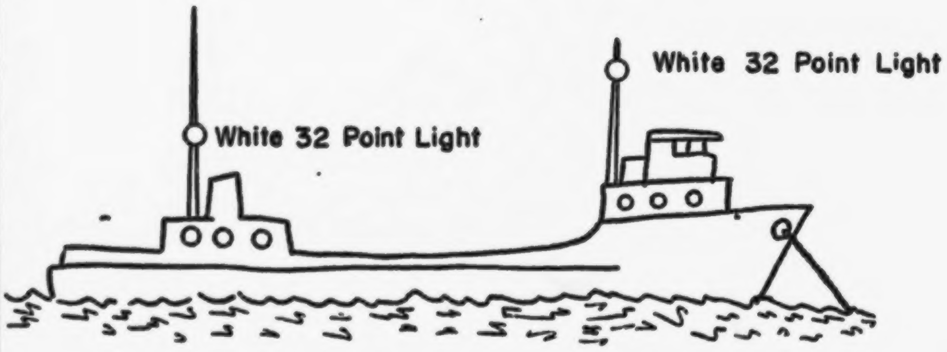
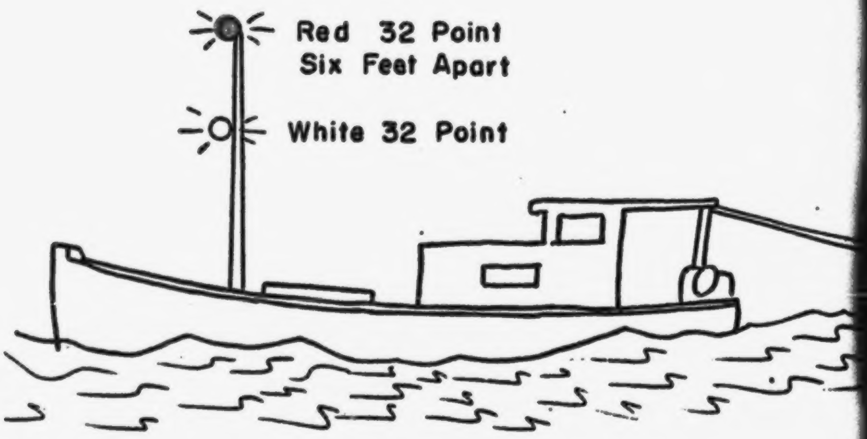

20 Point White Range Light 20 Ft. Above Gunwale
10 Point Green Light
10 Point Red Light
12 Point White Stern Light
20 Point White Range Light
12 Point White Stern Light
10 Point Green Side Light

Figure 10. Trawler Running Without Net Astern International Rules

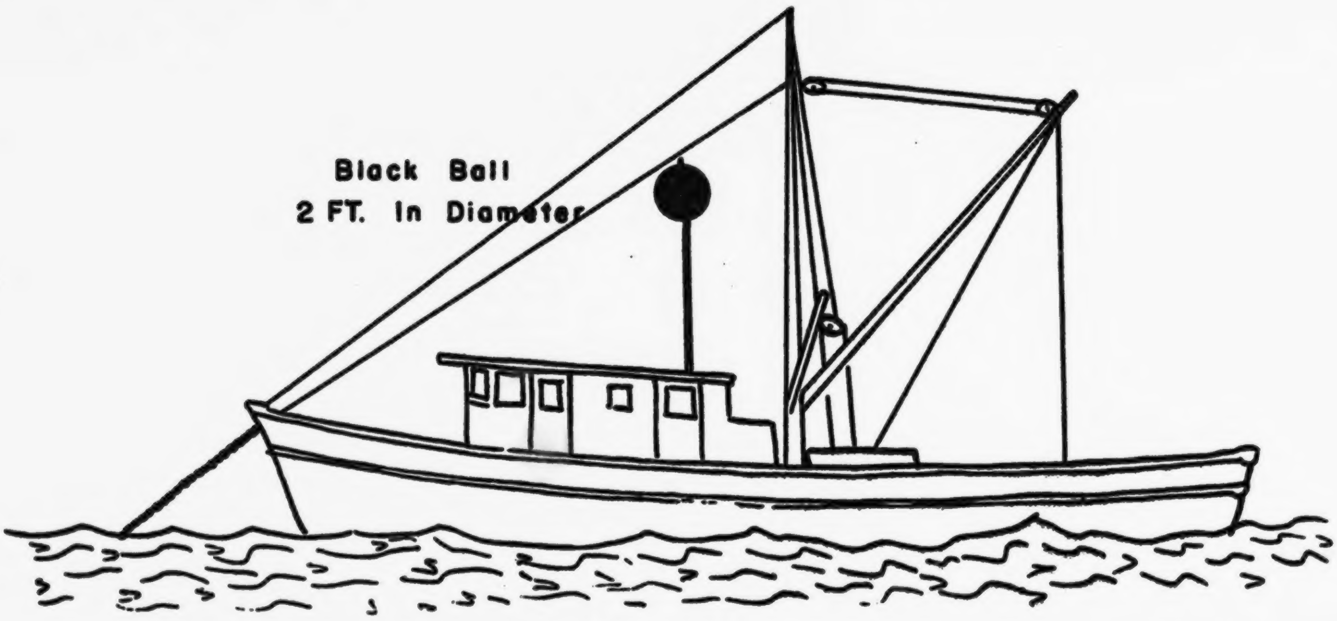
In Figure 11, we see examples of vessels at anchor, under inland and international rules. The vessel at anchor must display anchor lights by night and a anchor signal by day. The anchor signal by day is a black ball displayed well above the deck in the forward part of a vessel so that it may clearly be seen by other vessels. If the vessel is over 150 feet in length it carries two white 32 point lights, the forward being higher than the one aft and if it is less than 150 feet in length, one white light forward. Also in Figure 11 we have an illustration of a trawler operating in inland waters. Because it is usually operating at low speed, it does not carry the side lights or three colored lights as in international waters, but rather carries only a red light above a white light both visible through 32 points. There is an old saying among sailor men, when they see red over white, it means fishing at night. This is useful to one who is trying to learn or to remember what these lights mean.



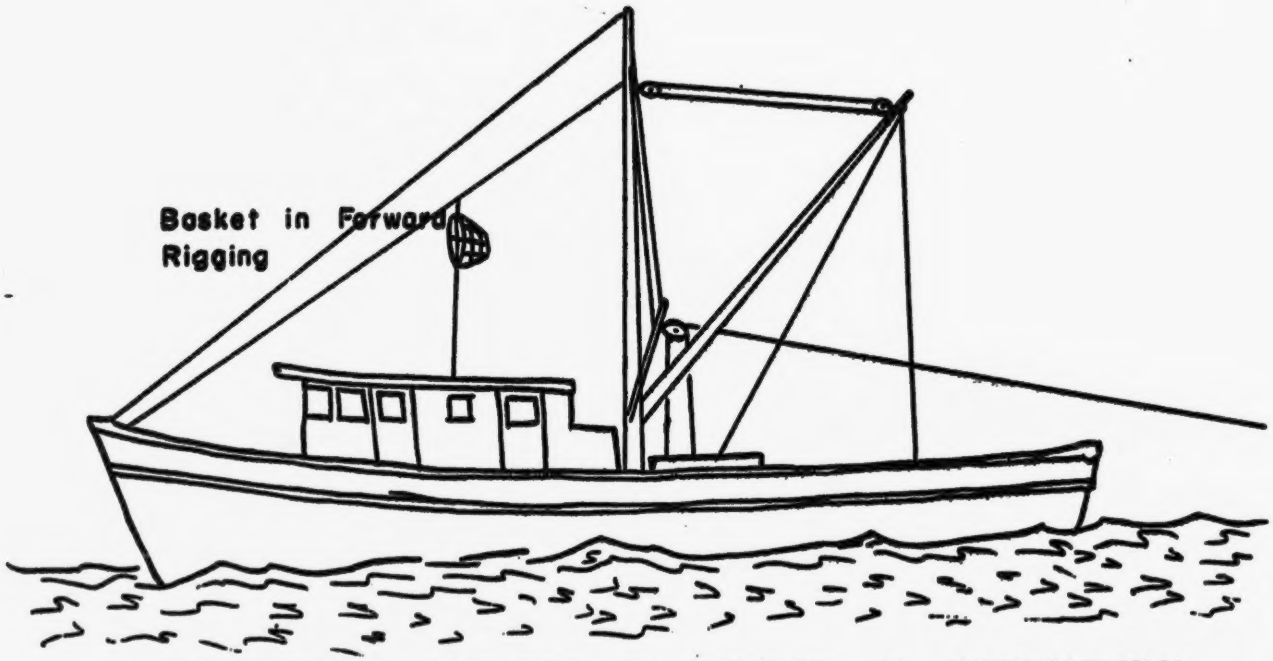
VESSEL OVER 150 FT. AT ANCHOR IN INTERNATIONAL WATERS
(Under 150 Ft. the forward light only is carried)



TRAWLER IN INLAND WATERS



VESSEL AT ANCHOR IN INTERNATIONAL WATERS
(Not required of vessels under 65' in inland waters)



DAY MARKER DISPLAYED BY TRAWLER IN INTERNATIONAL WATERS

Figure 11

ASSIGNMENTS: LESSON 2

I. Construct a table similar to the one shown in appendix "B" giving equipment required and recommended for vessels by classes.

II. Draw a diagram to show how the lights of a 200 ton steamship would appear to you if she was crossing your bow from port to starboard.

III. Make a list of lights and lanterns that should be part of the equipment of a class 3 crew boat engaged in transporting personnel from Morgan City to a drilling rig 20 miles south of ship shoal light.

IV. Draw a diagram showing the lights of a class 3 crew boat as seen from off her port quarter.

V. If the boat in assignment IV above were being overtaken by a class 1 vessel how would this vessel's lights appear to the overtaken boat? Show by drawing.

LESSONS 3 & 4

RULES OF THE ROAD

The "Rules of the Road" are designed to define right-of-way and avoid accidents. The rules define burdened vessels and privileged vessels, and the General Prudential Rule states that they are not to be construed as relieving a skipper of his responsibilities to avoid collision. If you are a privileged vessel in a dangerous situation you must carry every effort to avoid collision or damage even though you have the right-of-way. The statement, "he had the right-of-way" doesn't look well on a tomb stone. It should be emphasized that right-of-way is based on the ability of a vessel to give way, for example:

1. A sailing vessel has the right-of-way over a motor vessel except if it happens to be overtaking the motor vessel.
2. A vessel with a tow or a trawler both nets down has the right-of-way over a vessel without nets, that is, free to give way, except of course if it is the overtaking vessel.
3. A vessel not under command; that is, suffering a break down, must be avoided by other vessels which are able to give way.
4. A vessel in a channel has the right-of-way over a vessel crossing a channel.

Figure 12 illustrates what we commonly refer to as the danger zone. That is the area relative to our vessel from dead ahead to points abaft the starboard beam. All vessels approaching from this zone have right-of-way. Conversely she has right-of-way over vessels in any other position, to port or astern. Generally three conditions of right-of-way exist; (1) they are the meeting situation, where two vessels are meeting one another; (2) the crossing situation where two vessels are on courses which lead one to cross the bow of the other; (3) the overtaking situation where one vessel approaches another from astern. We will take up first the meeting situation.

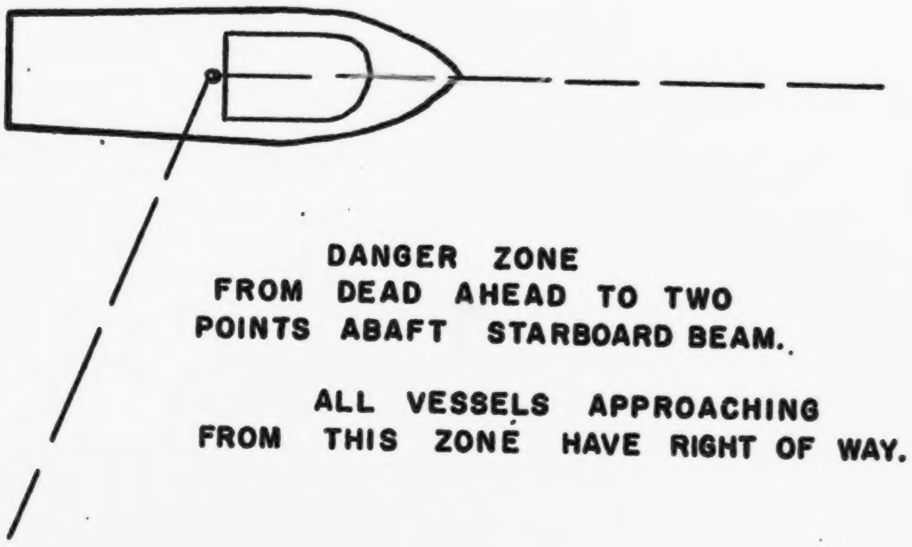
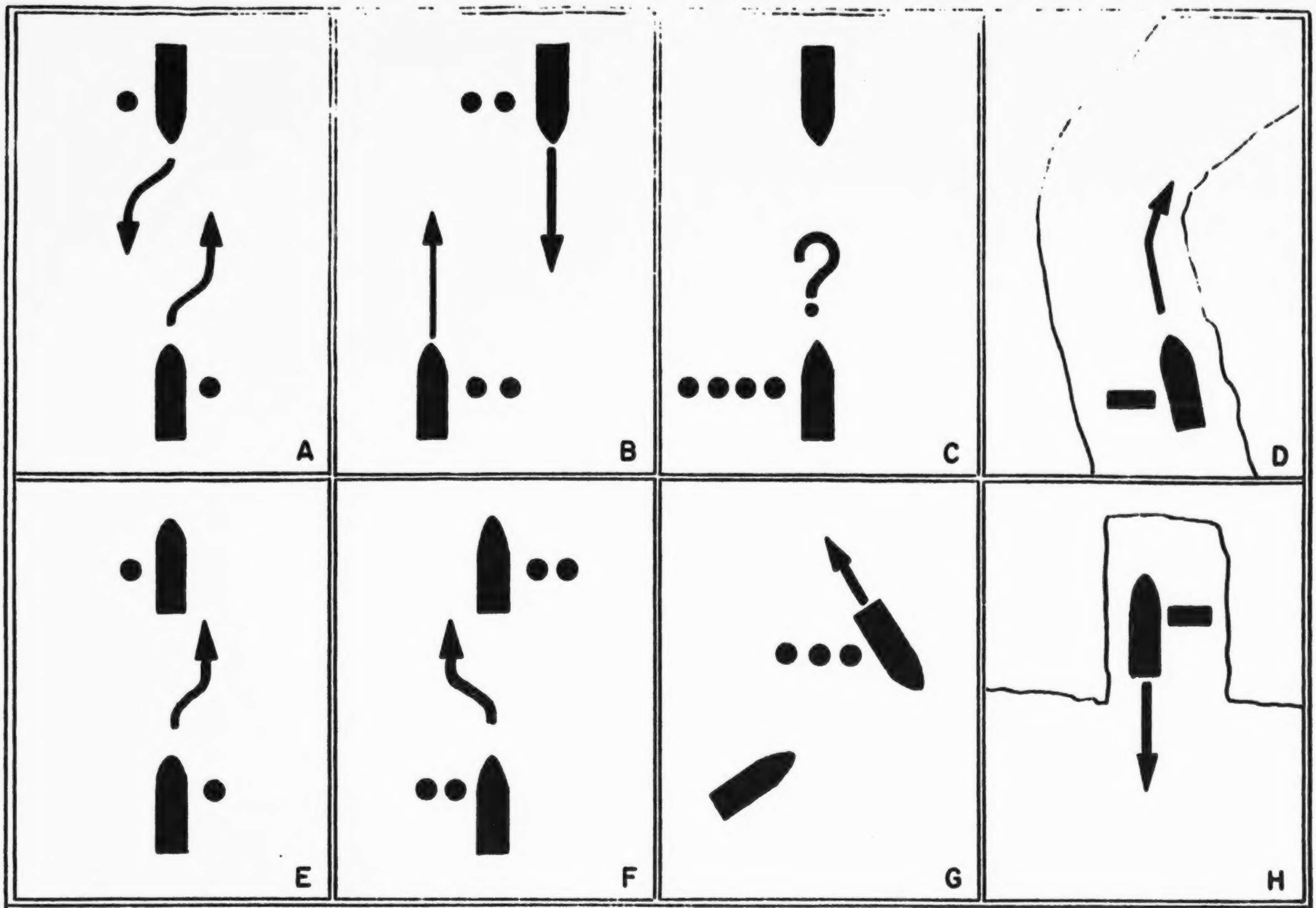

DANGER ZONE
FROM DEAD AHEAD TO TWO
POINTS ABAFT STARBOARD BEAM.
ALL VESSELS APPROACHING
FROM THIS ZONE HAVE RIGHT OF WAY.

Figure 12

as shown in illustration A of Figure 13.



A – VESSELS MEETING "HEAD TO HEAD." EACH SOUNDS ONE SHORT BLAST AND ALTERS COURSE TO STARBOARD.

B – VESSELS ON OPPOSITE PARALLEL COURSE TO STARBOARD OF EACH OTHER INDICATE INTENTION TO PASS STARBOARD TO STARBOARD BY EACH SOUNDING TWO SHORT BLASTS.

C – WHEN A VESSEL DOES NOT UNDERSTAND THE INTENTION OF ANOTHER THE DANGER SIGNAL – FOUR SHORT BLASTS ARE GIVEN.

D – VESSEL APPROACHING "BLIND" BEND SOUNDS ONE PROLONGED BLAST TO WARN OTHERS OF HER APPROACH.

E – OVERTAKING VESSEL DESIRING TO PASS TO STARBOARD OF VESSEL AHEAD SOUNDS ONE SHORT BLAST. VESSEL AHEAD ANSWERS WITH ONE SHORT BLAST TO GIVE CONCENT BUT ANSWERS WITH DANGER SIGNAL IF IT IS NOT SAFE FOR VESSEL ASTERN TO PASS.

F – OVERTAKING VESSEL SOUNDS TWO SHORT BLASTS TO PASS TO PORT OF VESSEL AHEAD.

G – VESSEL WITH HER ENGINES GOING ASTERN SOUNDS THREE SHORT BLASTS.

H – VESSELS BACKING OUT OF SLIP SOUNDS ONE PROLONGED BLAST.

NOTE: A "SHORT" BLAST IS ABOUT ONE SECOND DURATION.
A "PROLONGED" BLAST IS FOUR TO SIX SECONDS DURATION.

SIGNAL TO DRAW BRIDGE IS THREE LONG BLASTS, IF THE DRAW IS READY TO BE OPENED THE BRIDGE ANSWERS WITH THREE BLASTS, IF NOT, FOUR BLASTS.

Figure 13

Generally the procedure followed is that each ship will alter course to the right so as to pass port side to port side. Unless, that is, they are already far enough over as in illustration B of figure 13 to pass safely starboard to starboard without altering course. If either vessel is in doubt as to the best procedure to follow, then four (4) short blasts, the international danger signal should be given as shown in figure C of figure 13. Also shown in this illustration are the whistle signals to be used, one blast altering course to starboard passing to port, and two blasts if altering course to port in passing starboard to starboard as in illustration B in figure 13.

Now in the case of a crossing situation, if two vessels are approaching one another so that the track of one will cross the track of the other then the right-of-way rule as illustrated in figure 12 applies. The ship that has the other to starboard must give way, the ship that has the other to port has the right-of-way and should maintain course and speed except in an extreme emergency when maneuvering to avoid collision is required. It should be emphasized that the burdened vessel must relieve the situation by changing course or speed where as, the privileged vessel is obligated to maintain course and speed unless an extreme emergency arises. Here we see an application of the side lights, if you see a ship's red side light, then he would have to be in a position to your starboard and he would have the right-of-way. This rule is consistent with the illustration shown in figure 12.

The overtaking situation as illustrated in illustration E and F of figure 13. In any case a vessel being overtaken by another has the right-of-way. It is the duty of the vessel which is overtaking the other to request permission to pass by blowing one blast if she desires to pass to starboard and two blasts if she desires to pass to port. The vessel being overtaken, then, if she agrees will reply with like signal, if one blast has been blown and she agrees to permit the overtaking vessel to pass to starboard, then she will answer with one blast, if two blasts have given requesting permission to pass to port; and the overtaken vessel agrees to this procedure then she will reply with two blasts. Under no circumstance shall the burdened vessel pass until the privileged vessel answers its whistle signal. If the privileged vessel (overtaken) disagrees with the proposal of the burdened vessel then she should give the danger signal in reply at which time the burdened vessel may request permission to pass on the other side. Answering one blast with two or two blasts with one is expressly forbidden in the "Rules of the Road" and places the offending vessel liable.

There are several other whistle signals illustrated in figure 13; (1) one long blast for a vessel in a channel rounding a bend to warn vessels which are out of sight around the bend that he is approaching, (2) one long blast for a vessel leaving a slip or dock to warn vessels in the fair-way that he is leaving his anchorage or mooring and entering the fairway. (It is important to note that this is not a right-of-way signal and no passing signals may be exchanged until the vessel entering the fairway is clear of the slip or mooring.) Three (3) blasts illustrated in illustration G on figure 13 indicate "My Engines are going astern".

ASSIGNMENTS: LESSONS 3 & 4

I. Draw a diagram showing a vessel being approached by another in a:

   a. Meeting situation.

   b. Crossing situation.

   c. Overtaking situation.

   Indicate in each case the privileged and burdened vessels and the signals (if any) to be used by each.

II. State the General Prudential Rule.

III. Why do inland and international rules sometimes have different provisions for the same situation?

IV. What does "DANGER ZONE" mean as applied to the situations described in the first assignment.

V. Make a chart showing types of lights and kinds of vessels which are required to show these lights.

VI. Show by drawings how the lights of the burdened and privileged steam vessels will appear to each other in:

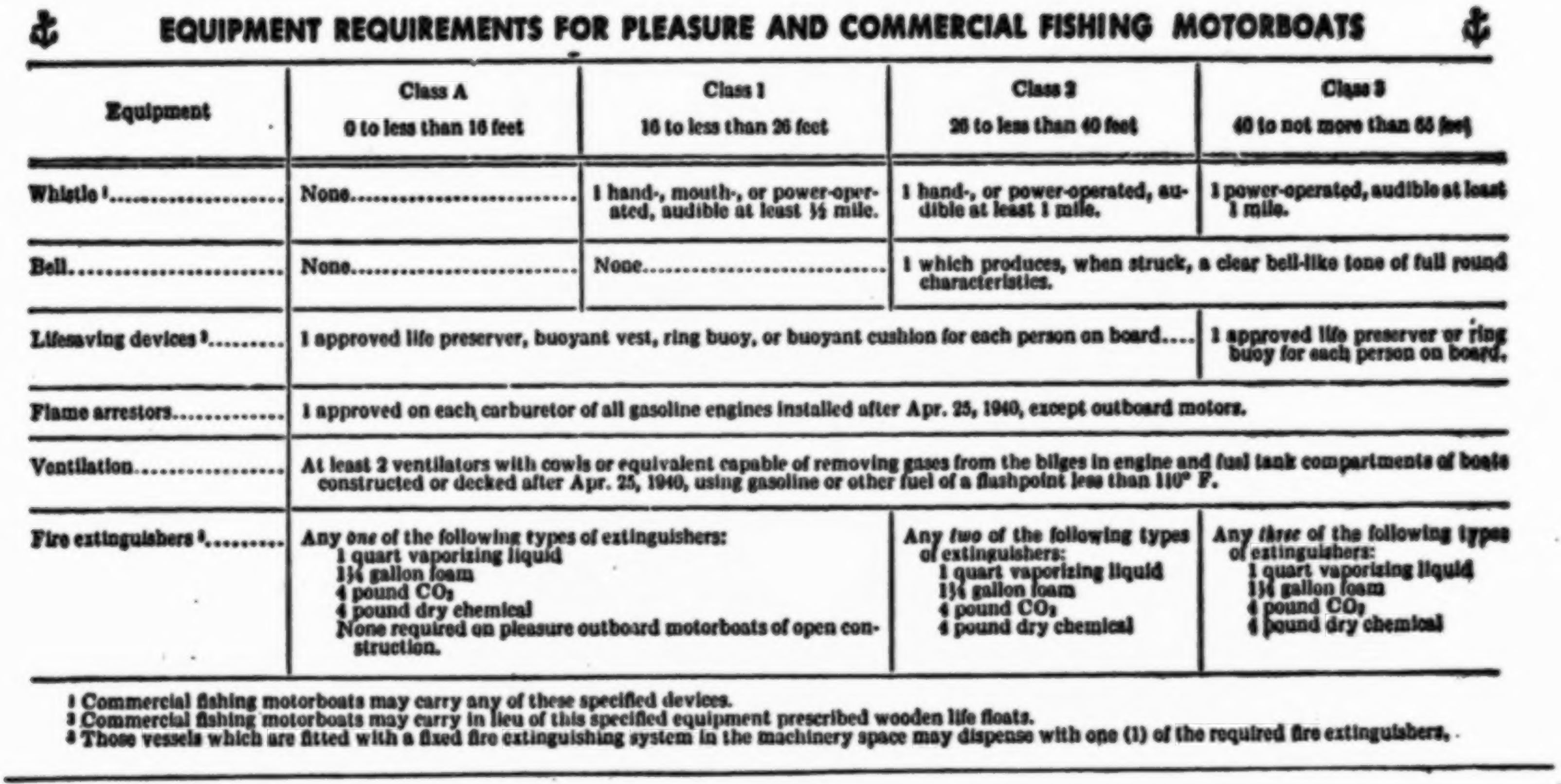
   a. Crossing situation.

   b. Overtaking situation.

LESSON 5

RECOMMENDED EQUIPMENT TO BE CARRIED ON SMALL CRAFT

Equipment requirements for pleasure and commercial fishing motor boats are shown in figure 14, by classes. The regulations provided for certain items which must be carried on board, such as; life saving equipment, navigation lights, running lights and so on. The boat operator, however, needs to provide himself with additional items of equipment in order to make his voyaging comfortable and safe. He should have certain spare parts on board; such as, spare navigational or running lights, an extra fire extinguisher or two, extra life jackets, signaling apparatus for emergencies and so on.



EQUIPMENT REQUIREMENTS FOR PLEASURE AND COMMERCIAL FISHING MOTORBOATS

Equipment	Class A 0 to less than 16 feet	Class 1 16 to less than 26 feet	Class 2 26 to less than 40 feet	Class 3 40 to not more than 65 feet
Whistle [1]	None	1 hand-, mouth-, or power-operated, audible at least ½ mile.	1 hand-, or power-operated, audible at least 1 mile.	1 power-operated, audible at least 1 mile.
Bell	None	None	1 which produces, when struck, a clear bell-like tone of full round characteristics.	
Lifesaving devices [2]	1 approved life preserver, buoyant vest, ring buoy, or buoyant cushion for each person on board.			1 approved life preserver or ring buoy for each person on board.
Flame arrestors	1 approved on each carburetor of all gasoline engines installed after Apr. 25, 1940, except outboard motors.			
Ventilation	At least 2 ventilators with cowls or equivalent capable of removing gases from the bilges in engine and fuel tank compartments of boats constructed or decked after Apr. 25, 1940, using gasoline or other fuel of a flashpoint less than 110° F.			
Fire extinguishers [3]	Any *one* of the following types of extinguishers: 1 quart vaporizing liquid 1¼ gallon foam 4 pound CO_2 4 pound dry chemical None required on pleasure outboard motorboats of open construction.		Any *two* of the following types of extinguishers: 1 quart vaporizing liquid 1¼ gallon foam 4 pound CO_2 4 pound dry chemical	Any *three* of the following types of extinguishers: 1 quart vaporizing liquid 1¼ gallon foam 4 pound CO_2 4 pound dry chemical

[1] Commercial fishing motorboats may carry any of these specified devices.
[2] Commercial fishing motorboats may carry in lieu of this specified equipment prescribed wooden life floats.
[3] Those vessels which are fitted with a fixed fire extinguishing system in the machinery space may dispense with one (1) of the required fire extinguishers.

Figure 14

The well equipped boat should have a satisfactory anchor, as well as a spare anchor, this anchor should be secured with chain or cable strong enough to hold in the most severe conditions, and should be of a size sufficient to hold the vessel in adverse weather and anchoring conditions. The operator should have some gear on board with which he can improvise a sea anchor for holding this ship's head up to the wind in the open water.

The navigation department must not be neglected in the well equipped boat. The operator should insure that he has adequate working space such as a chart table, on which to do his navigation plotting; he should have navigation instruments such as; dividers, parallel rules and so on besides a complete kit of charts for the area in which he is operating, and should have a reliable compass, time piece, and radio. The radio can be used for communications as well as for direction finding and obtaining navigational information. He should have publications such as light list, time tables and other publications which will give him the navigational information he needs.

The well equipped boat should be adequately provided with pumps. These pumps generally are of two classes, fixed pumps which are built into the vessel for pumping out bilges or other specific locations on the vessel, and portable pumps which may be moved about and also available for use in rendering assistance to other vessels, he should have lines, boat hooks, and other items of deck equipment which cannot be over looked by the conscientious shipper.

The equipment of a well rounded engine room must include spare parts for the machinery as well as tools for making repairs. The extent of tools and spare parts carried on a vessel should be consistent with the ability of the crew to use those spares. A typical fishing boat for example should carry spare injectors, but would not be expected to carry such things as a spare crank shaft; because the replacement of such a part would be difficult if not impossible to accomplish at sea.

The skipper should provide himself with signaling equipment such as; flares, flags, some sort of a blinker or flashing light signaling device together with the information necessary to make use of these items. And not to be neglected of course, is adequate first aid equipment. Some reputable physician should be consulted by the boat owner as to what items his first aid kit should contain. Generally speaking the items to be carried will depend upon the length of the cruise and the possibility of illness among the crew members.

Chapmans, Piloting, Seamanship and Small Boat Handling, page 102 shows the three anchors which should be carried aboard the well equipped vessel. This table given shows the weight of anchors recommended pre foot of boat length. Generally the requirements are for three anchors, a small kedge anchor, which is an auxiliary, the service anchor which is the one usually used and the heavy spare anchor which is stored away not for immediate use but never the less maintained in readiness, accessible so that it can be broken out and bent on for emergency use.

ASSIGNMENT: LESSON 5

I. Make a list of signaling equipment on your (or some other) boat. Put down the items in order of importance as you would buy them.

II. Make a list of navigational and plotting equipment to include everything you would want if you were fitting out a new boat of the (a) trawler class (b) crew boat class.

III. If you had a diesel main engine what are the three most important spare parts you would want to carry? What tools?

IV. In addition to;

a. Ground tackle.

b. Mooring lines.

c. Fishing gear (on trawler).

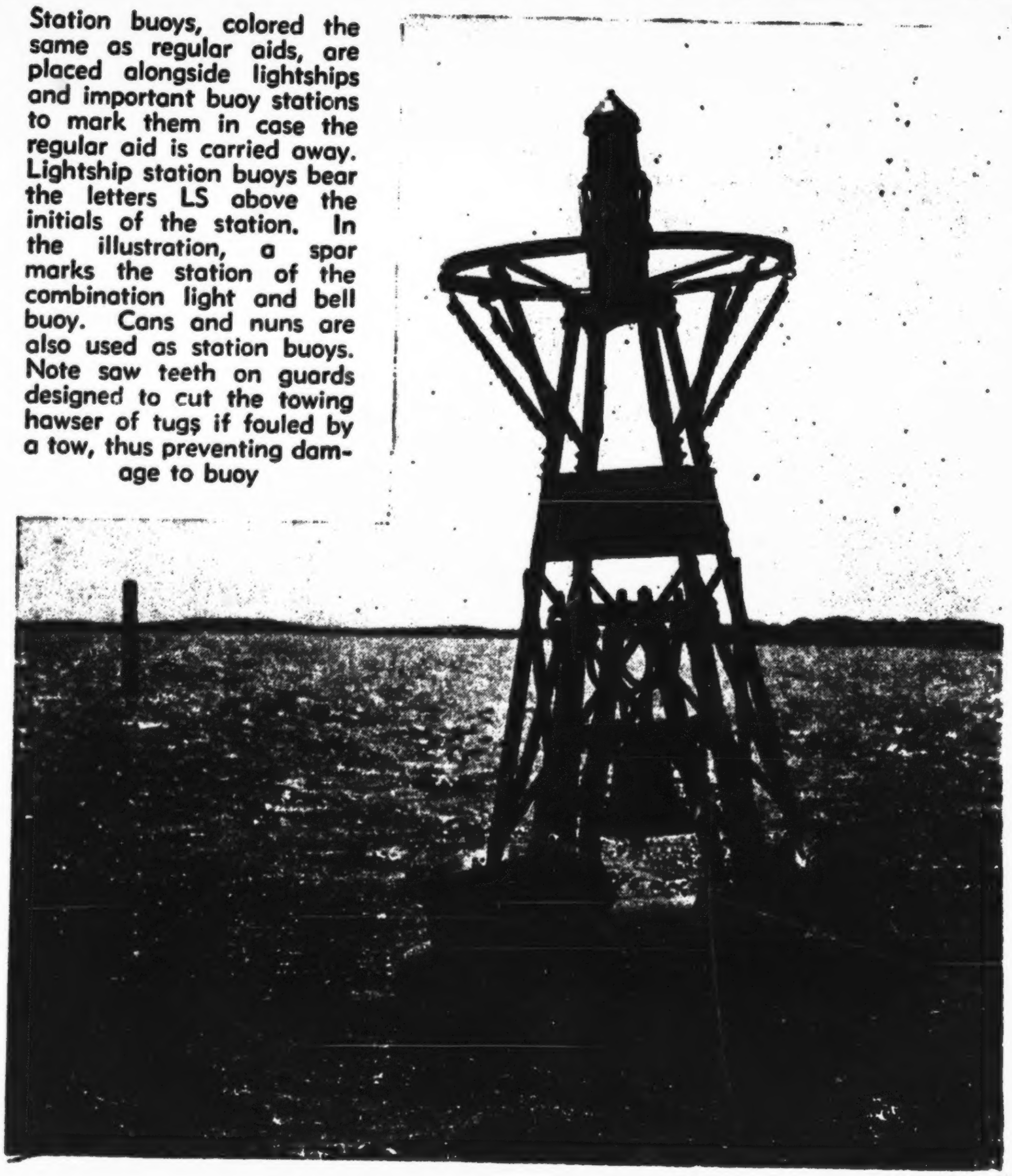
What other items of deck equipment would you recommend for a boat of 65 feet?

PART II AIDS TO NAVIGATION

LESSON 6

BUOYS AND MARKERS

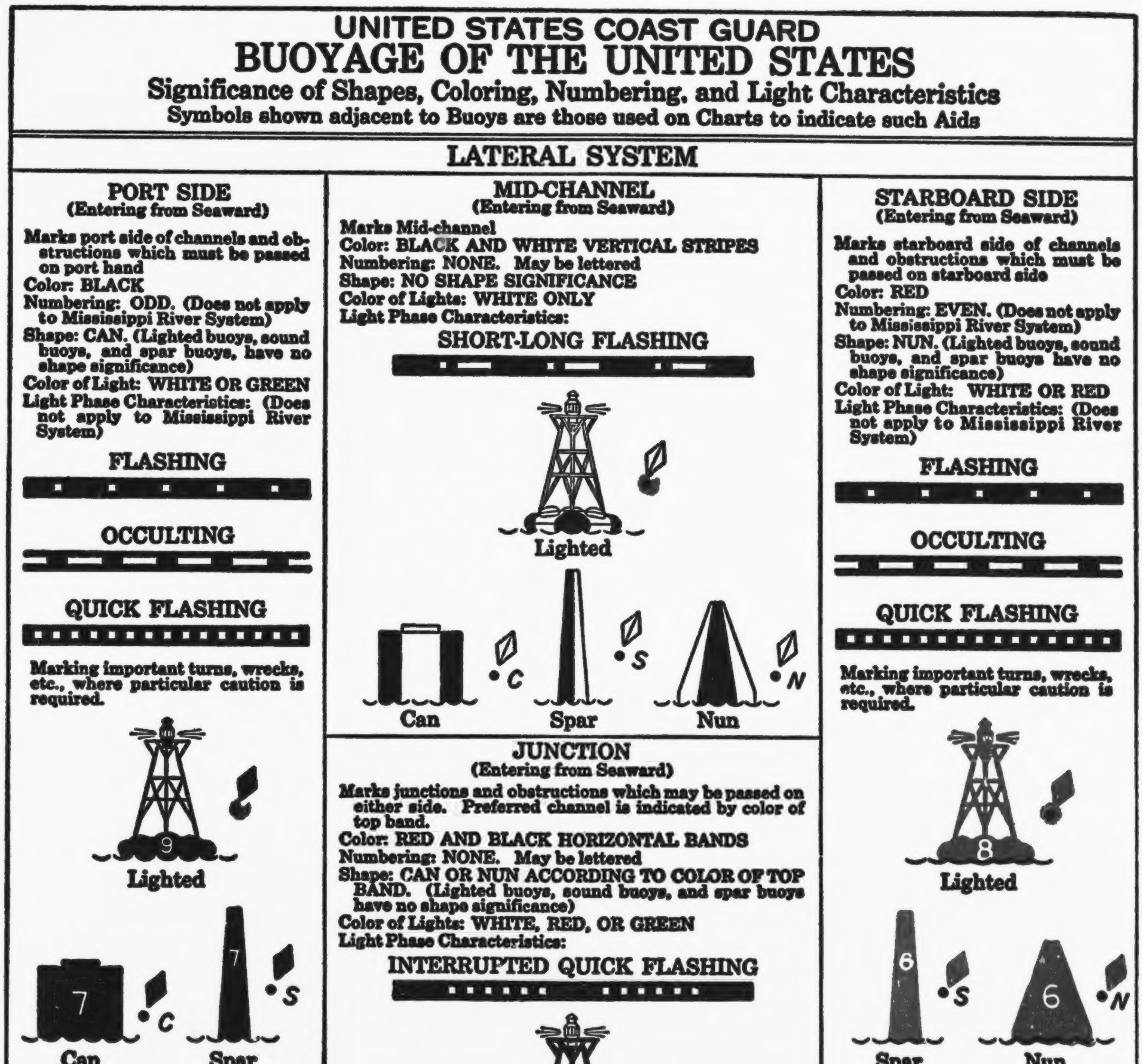
Figure 15, shows the familiar sea buoy. This is the sailor's friend which shows him (1) where the safe water is; (2) where the dangerous water is and (3) the way to his home port. There are many types of buoys and they serve many purposes. They mark channels and fairways; they mark safe water; they mark fair approaches to harbors and other areas where sailors desire to go; they mark anchorages; they mark dangers to navigation, such as, rocks and wrecks. The sailor needs to be familiar with these buoys and markers.



Station buoys, colored the same as regular aids, are placed alongside lightships and important buoy stations to mark them in case the regular aid is carried away. Lightship station buoys bear the letters LS above the initials of the station. In the illustration, a spar marks the station of the combination light and bell buoy. Cans and nuns are also used as station buoys. Note saw teeth on guards designed to cut the towing hawser of tugs if fouled by a tow, thus preventing damage to buoy

Figure 15

Illustrated in figure 16 are the buoys generally to be found in the waters of the U.S.. The characteristics of the lights when the buoys are lighted and the shapes of the buoys as well as their color is indicated. These buoys come in several different shapes. First is the lighted buoy, such as that shown in figure 15, and illustrated in figure 16. The lighted buoy may be red or black depending upon which side of the channel it is on or it may be combination white and black or even red and black, depending on where it is used. The unlighted bell buoy and the whistle buoy are also definite shapes. Then there is the can buoy, the nun buoy and the spar buoy, generally in marking a channel the can buoy will be used on one side and the spar buoy on the other, or the can buoy on one side and the nun buoy on the other, sometimes spars will be used on both sides. These buoys are designated on the chart by the letter "C" for can "S" for Spar, "N" for nun, so by looking at the chart the sailor can tell what type of buoy to look for. These buoys as already mentioned are in different colors. If in a channel entering port, the red buoys will be to the right and the black buoys will be to the left. When leaving port in a channel the black buoys kept to the starboard hand. The combination black and white buoy means mid-channel or mid-fairway and it may be passed to either side whether it be a lighted buoy, can, spar, or nun if it is painted in black and white vertical stripes then it may be passed to either side. A junction buoy is painted in black and red horizontal stripes. This buoy marks the place where two channels come together. It also may be passed to either side. Besides these there are a number of special buoys which are illustrated in figure 16. At the bottom of the page we see the striped special purpose buoy which may be used to indicate some special position described in current sailing instructions or in notices to mariners. Then there is the familiar yellow quarantine buoy, which indicated a quarantine anchorage and is used by ships awaiting permission to enter port. The white spar is the anchorage buoy; the one with the black band indicates a fish net and the one with the green top indicates a dredge. These buoys apply to international waters and channels, entrances to harbors and so on, but are in general use. There are however a set of special buoys which are illustrated in figure 17, (buoys are markers used in marking the intercoastal waterways.) These buoys and markers have the same coloring system, red and black, as the other buoys previously covered, with the exception that each one has a yellow border or top to indicate that it is an intercoastal waterway buoy or marker. You will notice in figure 17, that the can buoy has a yellow top, the spar buoy has a yellow top, the nun buoy has a yellow top and the beacon or targets have a yellow border, this is the designating and identifying figure of the intercoastal waterway type markers.



UNITED STATES COAST GUARD
BUOYAGE OF THE UNITED STATES
Significance of Shapes, Coloring, Numbering, and Light Characteristics
Symbols shown adjacent to Buoys are those used on Charts to indicate such Aids

LATERAL SYSTEM

PORT SIDE
(Entering from Seaward)

Marks port side of channels and obstructions which must be passed on port hand
Color: BLACK
Numbering: ODD. (Does not apply to Mississippi River System)
Shape: CAN. (Lighted buoys, sound buoys, and spar buoys, have no shape significance)
Color of Light: WHITE OR GREEN
Light Phase Characteristics: (Does not apply to Mississippi River System)

FLASHING

OCCULTING

QUICK FLASHING

Marking important turns, wrecks, etc., where particular caution is required.

MID-CHANNEL
(Entering from Seaward)

Marks Mid-channel
Color: BLACK AND WHITE VERTICAL STRIPES
Numbering: NONE. May be lettered
Shape: NO SHAPE SIGNIFICANCE
Color of Lights: WHITE ONLY
Light Phase Characteristics:

SHORT-LONG FLASHING

JUNCTION
(Entering from Seaward)

Marks junctions and obstructions which may be passed on either side. Preferred channel is indicated by color of top band.
Color: RED AND BLACK HORIZONTAL BANDS
Numbering: NONE. May be lettered
Shape: CAN OR NUN ACCORDING TO COLOR OF TOP BAND. (Lighted buoys, sound buoys, and spar buoys have no shape significance)
Color of Lights: WHITE, RED, OR GREEN
Light Phase Characteristics:

INTERRUPTED QUICK FLASHING

Where preferred channel is to STARBOARD the topmost band is BLACK

Where preferred channel is to PORT the topmost band is RED

STARBOARD SIDE
(Entering from Seaward)

Marks starboard side of channels and obstructions which must be passed on starboard side
Color: RED
Numbering: EVEN. (Does not apply to Mississippi River System)
Shape: NUN. (Lighted buoys, sound buoys, and spar buoys have no shape significance)
Color of Light: WHITE OR RED
Light Phase Characteristics: (Does not apply to Mississippi River System)

FLASHING

OCCULTING

QUICK FLASHING

Marking important turns, wrecks, etc., where particular caution is required.

BUOYS HAVING NO LATERAL SIGNIFICANCE

Color: AS SHOWN. Numbering: NONE. May be lettered. Light Phase Characteristics: Color of Lights: ANY EXCEPT RED OR GREEN

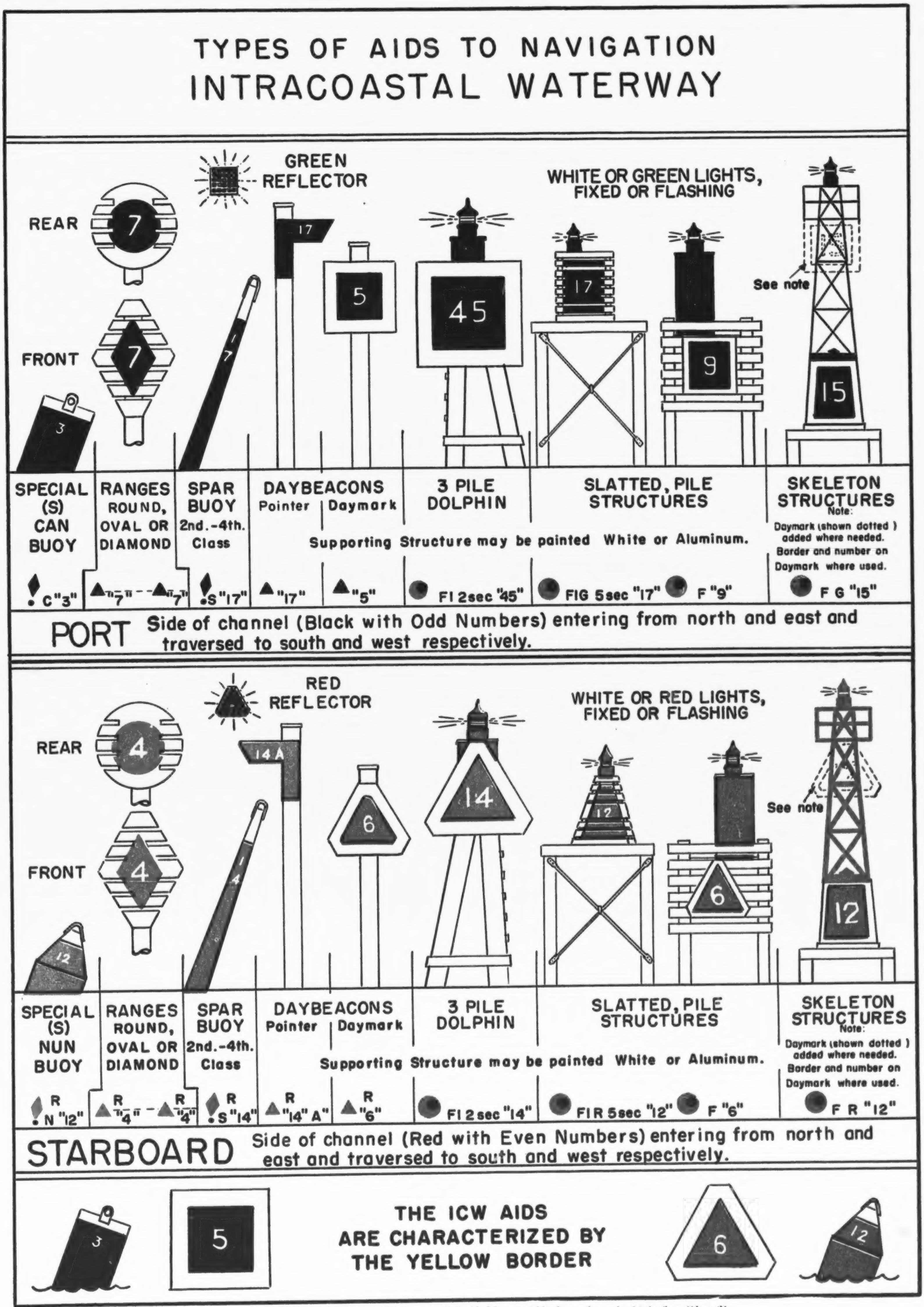
FIXED

FLASHING

OCCULTING

The significance of shapes, colors, numbers and light characteristics in the United States buoyage system.

Figure 16



TYPES OF AIDS TO NAVIGATION
INTRACOASTAL WATERWAY

PORT Side of channel (Black with Odd Numbers) entering from north and east and traversed to south and west respectively.

STARBOARD Side of channel (Red with Even Numbers) entering from north and east and traversed to south and west respectively.

Supporting Structure may be painted White or Aluminum.

THE ICW AIDS ARE CHARACTERIZED BY THE YELLOW BORDER

GREEN REFLECTOR
WHITE OR GREEN LIGHTS, FIXED OR FLASHING
REAR
FRONT
See note
SPECIAL (S) CAN BUOY
RANGES ROUND, OVAL OR DIAMOND
SPAR BUOY 2nd.-4th. Class
DAYBEACONS Pointer | Daymark
3 PILE DOLPHIN
SLATTED, PILE STRUCTURES
SKELETON STRUCTURES
Note: Daymark (shown dotted) added where needed. Border and number on Daymark where used.
C "3"
"7" - - "7"
S "17"
"17"
"5"
Fl 2sec "45"
FlG 5sec "17"
F "9"
F G "15"
RED REFLECTOR
WHITE OR RED LIGHTS, FIXED OR FLASHING
REAR
FRONT
See note
SPECIAL (S) NUN BUOY
RANGES ROUND, OVAL OR DIAMOND
SPAR BUOY 2nd.-4th. Class
DAYBEACONS Pointer | Daymark
3 PILE DOLPHIN
SLATTED, PILE STRUCTURES
SKELETON STRUCTURES
Note: Daymark (shown dotted) added where needed. Border and number on Daymark where used.
R N "12"
R "4" - - R "4"
R S "14"
R "14" A"
R "6"
Fl 2sec "14"
Fl R 5sec "12"
F "6"
F R "12"

Aids to navigation on the Intracoastal Waterway are distinguished by a special border or other mark painted yellow. Aids on this waterway are colored and numbered from north to south along the Atlantic Coast and from east to west on the Gulf Coast

Figure 17

ASSIGNMENT: LESSON 6

I. List the buoys to be seen in order from SW Pass to Calcasieu.

II. If you left SW Pass at 0800, speed 10 Kn, visibility 4 miles at what time would you except to sight Sabine bank and what if any other lights would be sighted enroute? (Give times on all sightings)

III. What is the meaning of a green buoy? How close may one be approached?

IV. Describe the difference between intercoastal and international waterway buoyage.

LESSON 7

LIGHTS

Figure 18, illustrates the lights commonly seen along our coastal waters. This light is usually on a structure of some kind, sometimes a tower of concrete but more often a frame structure as that shown in figure 18.

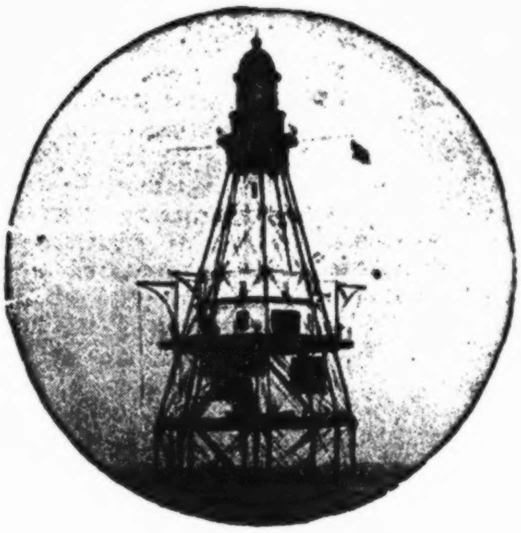


Figure 18

These lights generally are strong enough to be seen at great distances. It will be noted in table 8 of Bowditch (which is included here in figure 19), the distance to the horizon, that is the distance which an object may be seen at sea. This distance, of course, is determined by the curvature of the earth and depends on the height in feet of the eye of the observer, above the surface of the water. Looking at table 8 of Bowditch figure 19, we see that with the height of 19 feet the observer may see an object five miles away. With the height of 80 feet, it is possible to see an object 10 miles away, so as the distance increases the height must be increased greatly in order to be able to observe this object.

TABLE 8

Distance of the Horizon

Height feet	Nautical miles	Statute miles	Height feet	Nautical miles	Statute miles	Height feet	Nautical miles	Statute miles
1	1. 1	1. 3	120	12. 5	14. 4	940	35. 1	40. 4
2	1. 6	1. 9	125	12. 8	14. 7	960	35. 4	40. 8
3	2. 0	2. 3	130	13. 0	15. 0	980	35. 8	41. 2
4	2. 3	2. 6	135	13. 3	15. 3	1, 000	36. 2	41. 6
5	2. 6	2. 9	140	13. 5	15. 6	1, 100	37. 9	43. 7
6	2. 8	3. 2	145	13. 8	15. 9	1, 200	39. 6	45. 6
7	3. 0	3. 5	150	14. 0	16. 1	1, 300	41. 2	47. 5
8	3. 2	3. 7	160	14. 5	16. 7	1, 400	42. 8	49. 3
9	3. 4	4. 0	170	14. 9	17. 2	1, 500	44. 3	51. 0
10	3. 6	4. 2	180	15. 3	17. 7	1, 600	45. 8	52. 7
11	3. 8	4. 4	190	15. 8	18. 2	1, 700	47. 2	54. 3
12	4. 0	4. 6	200	16. 2	18. 6	1, 800	48. 5	55. 9
13	4. 1	4. 7	210	16. 6	19. 1	1, 900	49. 9	57. 4
14	4. 3	4. 9	220	17. 0	19. 5	2, 000	51. 2	58. 9
15	4. 4	5. 1	230	17. 3	20. 0	2, 100	52. 4	60. 4
16	4. 6	5. 3	240	17. 7	20. 4	2, 200	53. 7	61. 8
17	4. 7	5. 4	250	18. 1	20. 8	2, 300	54. 9	63. 2
18	4. 9	5. 6	260	18. 4	21. 2	2, 400	56. 0	64. 5
19	5. 0	5. 7	270	18. 8	21. 6	2, 500	57. 2	65. 8
20	5. 1	5. 9	280	19. 1	22. 0	2, 600	58. 3	67. 2
21	5. 2	6. 0	290	19. 5	22. 4	2, 700	59. 4	68. 4
22	5. 4	6. 2	300	19. 8	22. 8	2, 800	60. 5	69. 7
23	5. 5	6. 3	310	20. 1	23. 2	2, 900	61. 6	70. 9
24	5. 6	6. 5	320	20. 5	23. 6	3, 000	62. 7	72. 1
25	5. 7	6. 6	330	20. 8	23. 9	3, 100	63. 7	73. 3
26	5. 8	6. 7	340	21. 1	24. 3	3, 200	64. 7	74. 5
27	5. 9	6. 8	350	21. 4	24. 6	3, 300	65. 7	75. 7
28	6. 1	7. 0	360	21. 7	25. 0	3, 400	66. 7	76. 8
29	6. 2	7. 1	370	22. 0	25. 3	3, 500	67. 7	77. 9
30	6. 3	7. 2	380	22. 3	25. 7	3, 600	68. 6	79. 0
31	6. 4	7. 3	390	22. 6	26. 0	3, 700	69. 6	80. 1
32	6. 5	7. 5	400	22. 9	26. 3	3, 800	70. 5	81. 2
33	6. 6	7. 6	410	23. 2	26. 7	3, 900	71. 4	82. 2
34	6. 7	7. 7	420	23. 4	27. 0	4, 000	72. 4	83. 3
35	6. 8	7. 8	430	23. 7	27. 3	4, 100	73. 3	84. 3
36	6. 9	7. 9	440	24. 0	27. 6	4, 200	74. 1	85. 4
37	7. 0	8. 0	450	24. 3	27. 9	4, 300	75. 0	86. 4
38	7. 1	8. 1	460	24. 5	28. 2	4, 400	75. 9	87. 4
39	7. 1	8. 2	470	24. 8	28. 6	4, 500	76. 7	88. 3
40	7. 2	8. 3	480	25. 1	28. 9	4, 600	77. 6	89. 3
41	7. 3	8. 4	490	25. 3	29. 2	4, 700	78. 4	90. 3
42	7. 4	8. 5	500	25. 6	29. 4	4, 800	79. 3	91. 2
43	7. 5	8. 6	520	26. 1	30. 0	4, 900	80. 1	92. 2
44	7. 6	8. 7	540	26. 6	30. 6	5, 000	80. 9	93. 1
45	7. 7	8. 8	560	27. 1	31. 2	6, 000	88. 6	102. 0
46	7. 8	8. 9	580	27. 6	31. 7	7, 000	95. 7	110. 2
47	7. 8	9. 0	600	28. 0	32. 3	8, 000	102. 3	117. 8
48	7. 9	9. 1	620	28. 5	32. 8	9, 000	108. 5	124. 9
49	8. 0	9. 2	640	28. 9	33. 3	10, 000	114. 4	131. 7
50	8. 1	9. 3	660	29. 4	33. 8	15, 000	140. 1	161. 3
55	8. 5	9. 8	680	29. 8	34. 3	20, 000	161. 8	186. 3
60	8. 9	10. 2	700	30. 3	34. 8	25, 000	180. 9	208. 2
65	9. 2	10. 6	720	30. 7	35. 3	30, 000	198. 1	228. 1
70	9. 6	11. 0	740	31. 1	35. 8	35, 000	214. 0	246. 4
75	9. 9	11. 4	760	31. 5	36. 3	40, 000	228. 8	263. 4
80	10. 2	11. 8	780	31. 9	36. 8	45, 000	242. 7	279. 4
85	10. 5	12. 1	800	32. 4	37. 3	50, 000	255. 8	294. 5
90	10. 9	12. 5	820	32. 8	37. 7	60, 000	280. 2	322. 6
95	11. 2	12. 8	840	33. 2	38. 2	70, 000	302. 7	348. 4
100	11. 4	13. 2	860	33. 5	38. 6	80, 000	323. 6	372. 5
105	11. 7	13. 5	880	33. 9	39. 1	90, 000	343. 2	395. 1
110	12. 0	13. 8	900	34. 3	39. 5	100, 000	361. 8	416. 5
115	12. 3	14. 1	920	34. 7	39. 9	200, 000	511. 6	589. 0

Figure 19

Now if the observer has a height of eye of 10 feet above the water and the light that he is looking for is 50 feet above the water then he should add the visibility for 10 feet to the visibility for 50 feet. Since the table uses water level as zero and the light lists assume a height of eye of 15 feet some discrepancy may be seen. In other words a light may be picked up later than anticipated unless this is taken into consideration. Taking another example if the observer is 20 feet above the water and the light is 100 feet above the water then visibility for 100 feet, 11.4 miles, plus visibility for 20 feet which is 5.1 miles equals 16.5 miles, the distance at which the light should appear.

These lights, as a sailor observes them, have various characteristics. Some of them are flashing; that is the light is on for a short period of time possibly a half of a second and then off for a longer period of time possibly as much as 10 or 15 seconds. Sometimes the light will flash several times before it goes off and in this case the light will be designated on the chart as a group flashing light. A group flashing light may flash 3, 5, 8, 10 times and the number of flashes will be indicated on the chart.

The second characteristic light is the occulting light, that is a light which is on for a longer period of time than it is off. It may be a single occulting light which is on for say 8 seconds and off for 2, or it may be a group occulting light, which is off for 3 - 2 second periods, and then on for 20 seconds. Sometimes a light may alternate, it may be a white light with alternating red flashes, that is, it will show white, for example, 10 seconds, then show two quick red flashes, or three quick red flashes and then show white again for 10 seconds. Sometimes a light will be flashing, that is it will flash continuous, it may be flashing white, it may be flashing green, it may be flashing red, it may flash alternately red and white. This information is given on the chart and the light may be identified from the chart as well as from the light list by its appearance. The sailor should familiarize himself with the characteristics of lights in the region in which he is sailing, if he is going into a strange area, he should first study from the chart and the light list, the lights which will be encountered on his voyage so that he will be able to identify them as soon as they are sighted.

ASSIGNMENTS: LESSON 7

I. Using Bowditch table 8 (figure 19) determine the range of visibility of (use 15' height of eye.)

  a. South West Pass light - 1116 (chart)

  b. Ship shoal light

  c. Sabine bank light

  d. Galveston light

  e. Barataria bay light

II. How far away could you see each of the above lights from a 65' mast?

III. If each of the lights in (1) above were 15' higher how far would they be visible?

IV. You are traveling from New Orleans to Tampa, Florida along the 10 fathom curve. Make a list of the lights that will be seen during the cruise in the order of their appearance.

V. Make a similar list for a cruise from Key West to Miami, Florida.

LESSON 8

CHARTS

This lesson is designed to introduce the student to the nautical chart. The nautical chart is a difficult thing to construct because what the cartographer or chart maker has to do is try to show on a flat surface such as a piece of paper, the surface of the earth which is really round, so in order to get this round surface into a flat surface, a certain amount of stretching and distortion is necessary. Several different methods have been tried to accomplish this, and possibly the best one is the Mercator type projection. This Mercator type projection is derived as shown in figure 20, by wrapping

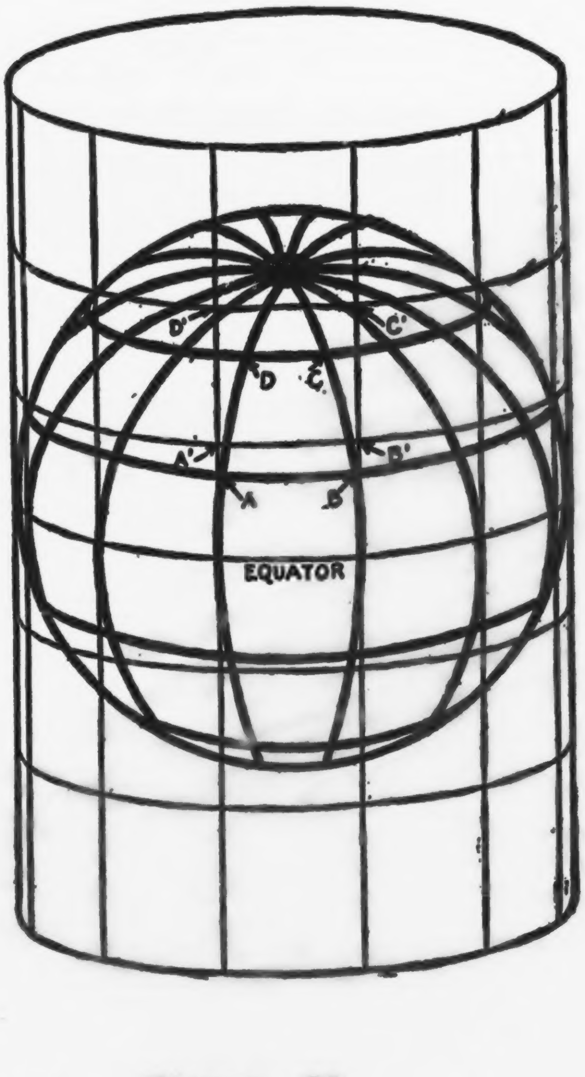


Figure 20

a piece of paper around the globe and by identifying points around the globe with points on the piece of paper. In order to maintain relative distances the paper must be stretched up and down so that the shape of a given area of land or sea on the chart, will be similar or close to the shape of the land mass or water area as it actually exists.

Another type of projection is shown in Figure 21. This is the polyconic type of projection and a map so constructed appears in Figure 22. This is a map of North America and it will be seen that the shape of the map here produced is similar to the shape of the actual land mass as it lies. Now if the illustration in Figure 23 is compared with Figure 22 it will be seen that the Mercator projection stretches out the northern latitudes, Canada and Alaska in Figure 23, are out of shape or enlarged from their true size as compared with Figure 22. In spite of this fact the Mercator projection is the best navigational chart for most purposes because

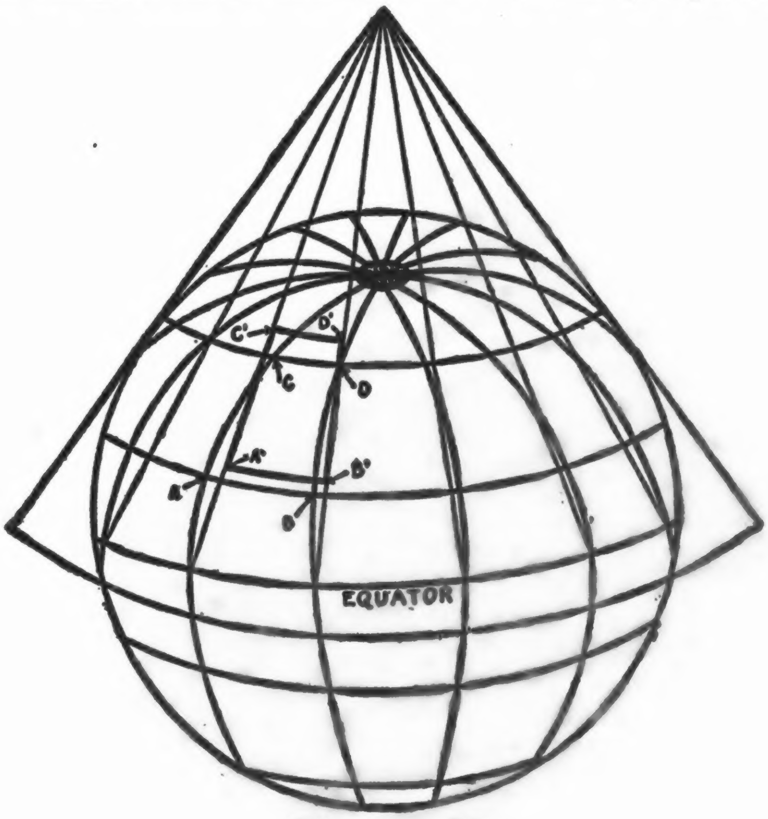
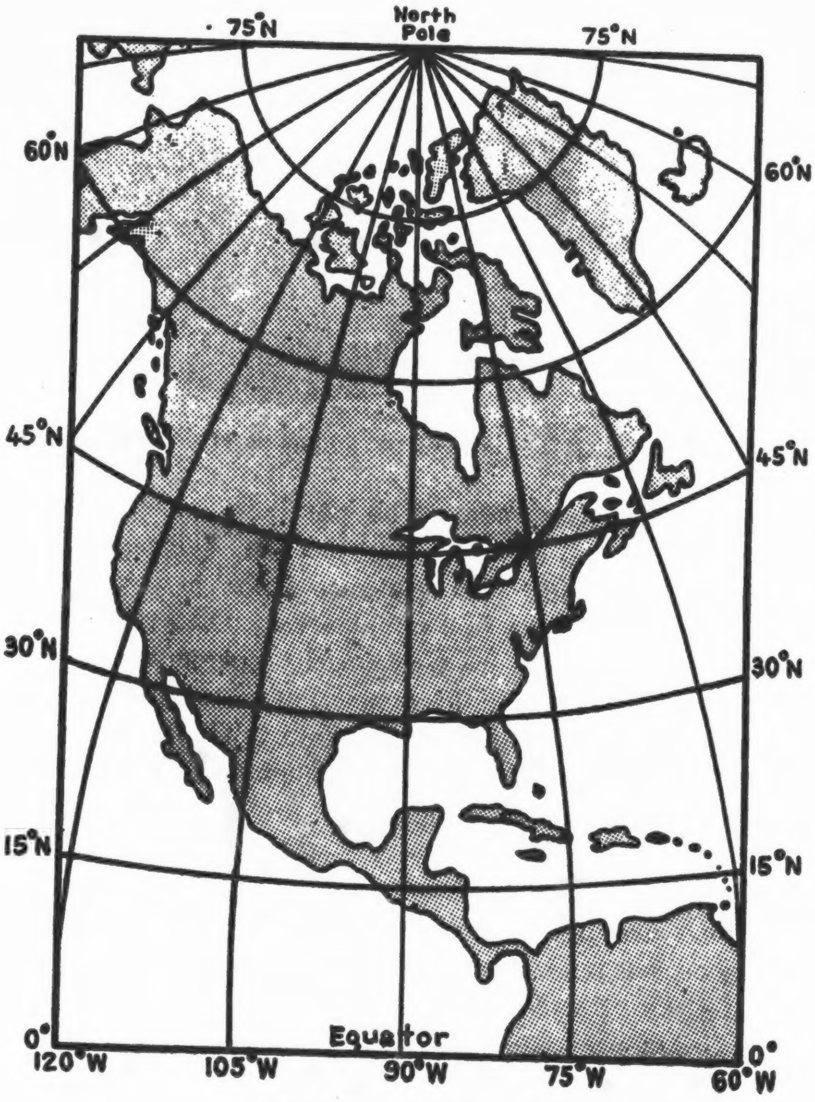


Figure 21



-A polyconic map of North America.

Figure 22

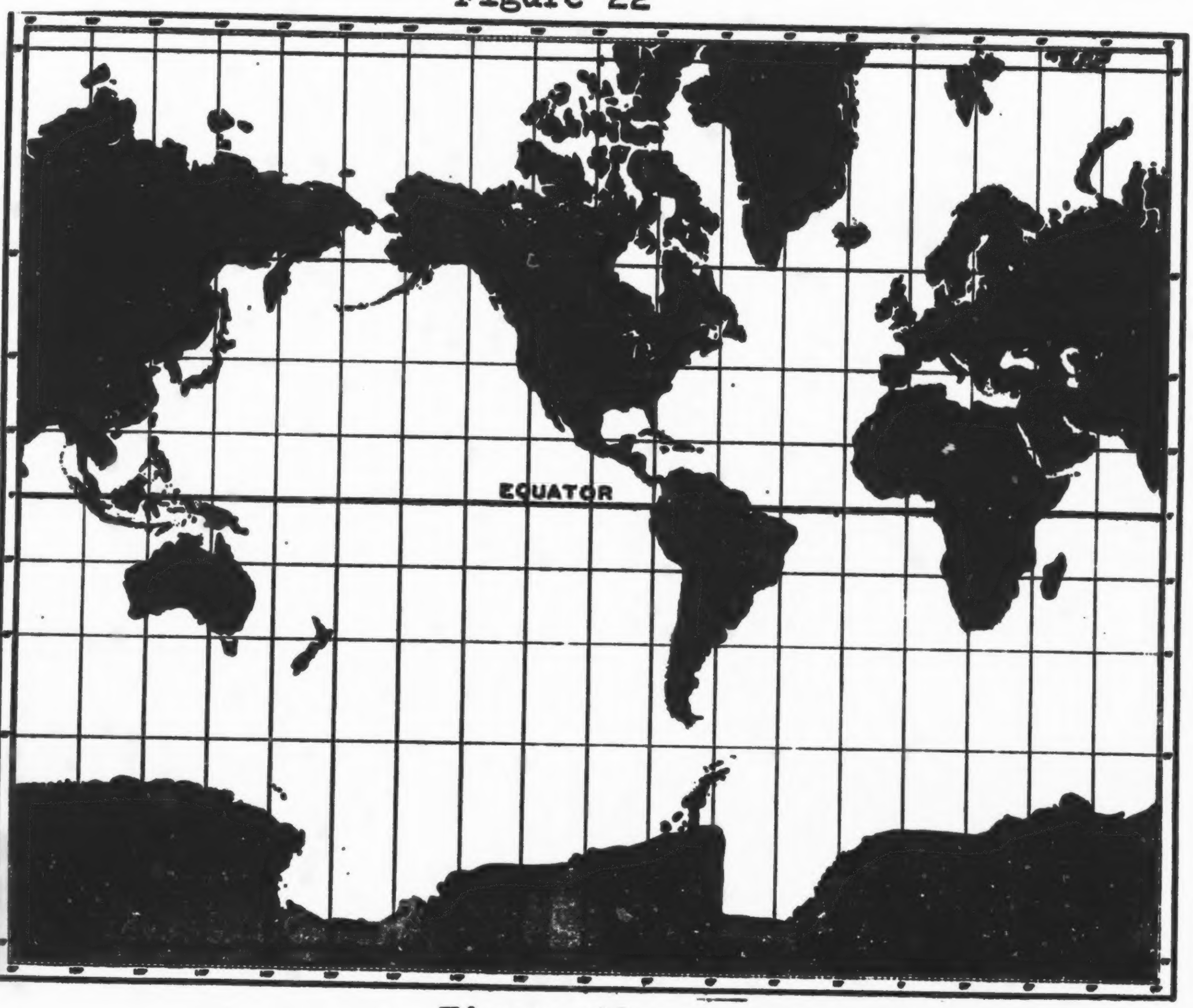
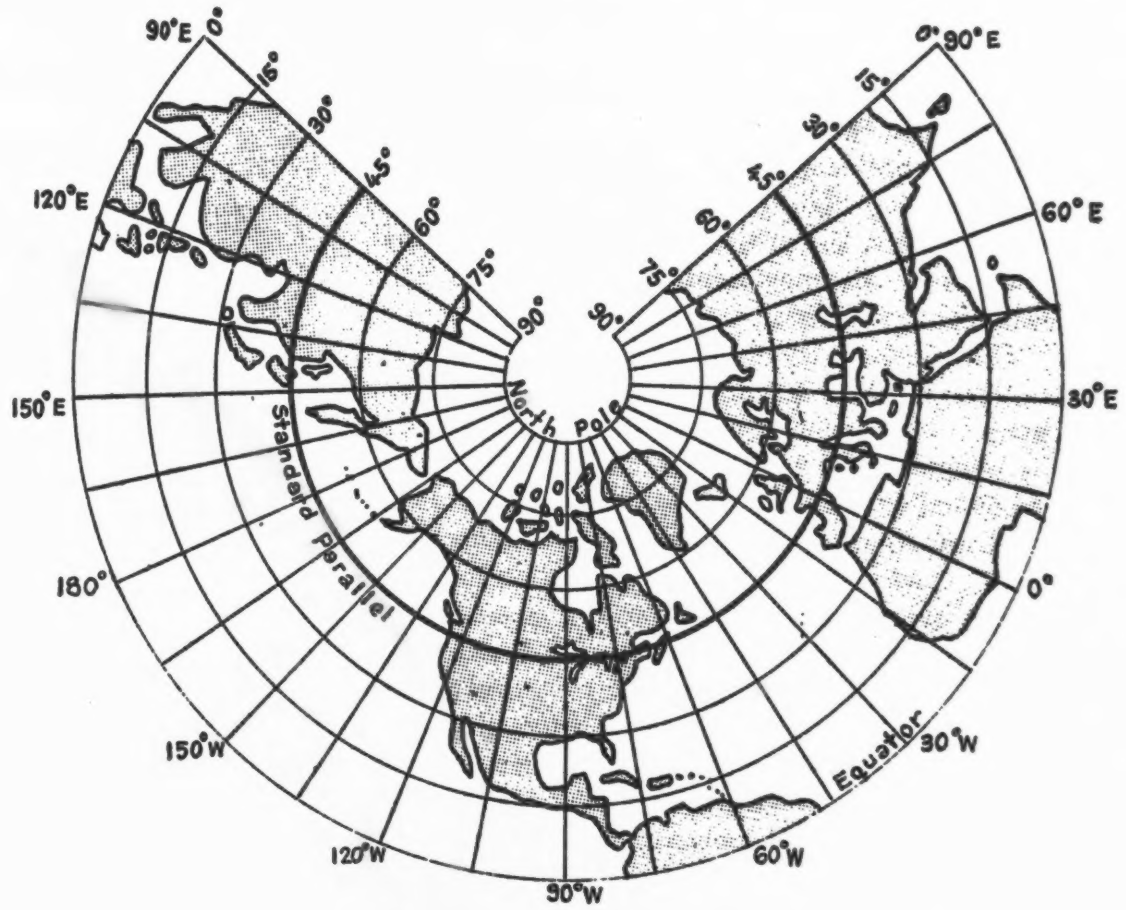


Figure 23 -A Mercator map of the world.

North is still North and South is still South on a Mercator projection, whereas, in the polyconic projection directions are changed and the navigator of course is primarily concerned with directions.

A third type of projection is the conic projection, an example of which appears in Figure 24. This is a simple projection in which the map is made by just unrolling a part of the globe. This is not good for navigation but is good for purposes of discussing the distances and positions of land masses with respect to each other



–A simple conic map of the northern hemisphere.

Figure 24

ASSIGNMENTS: LESSON 8

I. What is the difference between the Mercator and polyconic projections?

II. Why is the Mercator projection generally used for piloting?

III. If a boat departs SW pass (Vermilion Bay) at 0900 and runs on 180°T until 1200 at 10 knots what will be the depth of water .

IV. If a boat runs from SW pass (Vermilion Bay) for 4 hours on course 150°T at 12 knots, what will be his latitude and longitude?

LESSON 9

THE USE OF CHARTS IN PILOTING

The Mercator projection as shown in Figure 24 represents the best effort of the cartographer to produce a workable chart. Taken by small parts the Mercator projection is very accurate. The small area shown in Figure 24 in the center of the illustration which includes the Gulf of Mexico region on a Mercator projection is very accurate as to distances and directions, of course if we get into the extreme latitudes we see for example that the Antarctic continent down to the south is distorted and all out of proportion as to the size, but if we stick to small areas in the Mercator projection we can plot very accurately.

Now examinining the Mercator projection we see that the only true distance shown is that along the equator, however, if we go north or go south from the equator a certain amount of stretching out has to be done to preserve the shape of the continents and to keep them from looking flattened out so the scale on the side of the chart must be the one used for plotting distances. If we use the scale that goes across the chart the only place it would be accurate is at the equator, but if we use north and south scale and apply it to a small area, only then it could measure with great accuracy. If the student will examine a Mercator chart such as, C & CS number 1116, it shows the Gulf Coast region from the Mississippi River to Galveston, Texas. He will see that the chart shows all the land marks, depth of water, and aids to navigation necessary for plotting the course. He will note that first the depths of water are indicated in fathoms. The actual depth of the water is indicated right on the chart. In addition to the depth of water being given by fathoms, curves have been drawn on the chart which indicates location of equal depths. The first curve as we come to shore in the blue region is the five fathom curve. We see on examining this curve that it is composed of intervals of five dots. Coming on out we see the 10 fathom curve, which is a dividing line between the blue area and the white area, of the chart. This curve is drawn with alternate dashes and dots. This is a 10 fathom curve the one dot between the two dashes standing for 10 fathoms, coming on out we see that 20 fathom curve which is drawn with two dots and a dash, two dots for 20 fathoms and on out 30 fathoms is shown by three dots, three for 30, forty fathoms, four dots, 50 fathoms five dots, right on out, each dot in a curve indicates 10 fathoms so five dots indicates 50 fathoms. The hundred fathom curve is shown by dashes and all other curves on out to great depths of 500 fathoms or more are shown by dashes with the number of fathoms being written in. We see a series of dashes with the number 100 written in, right south of ship shore light at distance of about 20 miles indicating the location of 100 fathom curve.

The longitude and latitude scales should be examined now to arrive at a means of laying out distances on the chart. It will be noted that the longtitude scale is the same across the top and the bottom of the chart in a Mercator projection. If however, a distance is picked off a longtitude scale and used on the chart, it will be found to be inaccurate, due to the stretching of the chart east and west as we move away from the equator. This is as was already discussed; the latitude scale on the other hand is different as we go north and south. If we will look at the right or left margin of the chart and pick off a distance of about 2 miles, near the northern end of the scale and then apply that distance near the southern end of the scale we will find a difference or a discrepancy which indicates that in using the latitude scale for laying off distances the navigator should make sure that he uses that part of the scale which is for the approximate latitude with which he is working, if he is working with 30° north latitude then he should use the latitude scale for 30°, if he is working 20° north latitude, then he should use latitude scale for 20°, and so on. Thus he can use extreme accuracy in his chart work.

Now if the chart is further examined we can see the markings of buoys already discussed in a previous section, we can see the characteristics for example of the sea buoy south of ship shore light. The chart indicates that this buoy flashes white, that the buoy is numbered two, that is the number 2 may be seen on the bouy, and that it is a whistle buoy. We may also see from information on the chart that this is a radar reflector buoy, (indicated by the letters Ra Ref), which means that the buoy is so constructed that radar ranges may be taken off of it if one is equipped with radar. The characteristics of lights may be also seen on this chart. If we will examine the data at ship shoal light, we will see that ship shoal light is named, that we are told that it flashes every 10 seconds, and is 105 feet in height, that it should be visible 60 miles. The navigator can by working carefully, determine his position accurately at almost any time, the location of lights, buoys, and coast line figures, as well as depth of water, is clearly given on the chart and may be accurately determined in shallow water by the use of a lead line, or depth recorder as shown in Figure 25.

DEPTH RECORDER

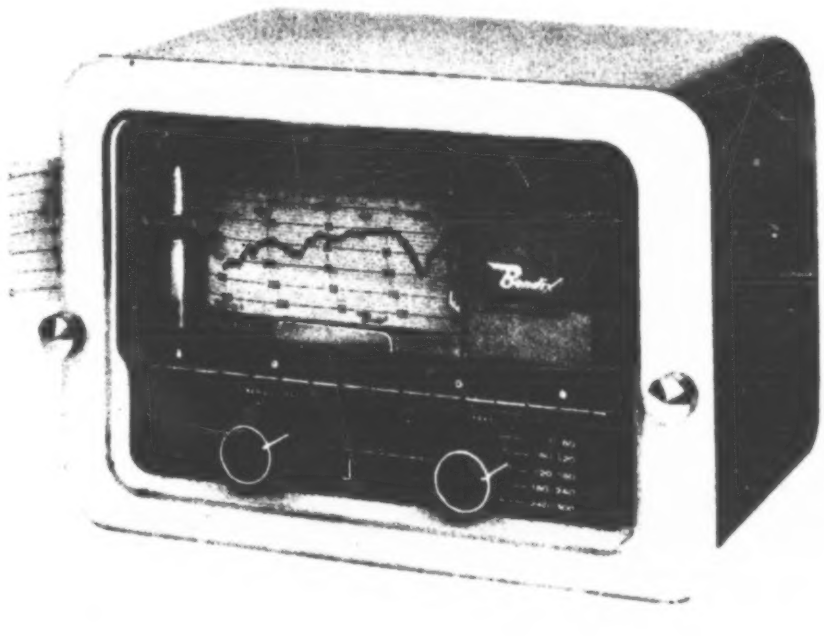


Figure 25

By means of the compass rose as shown in Figure 26, he may accurately lay off his courses.

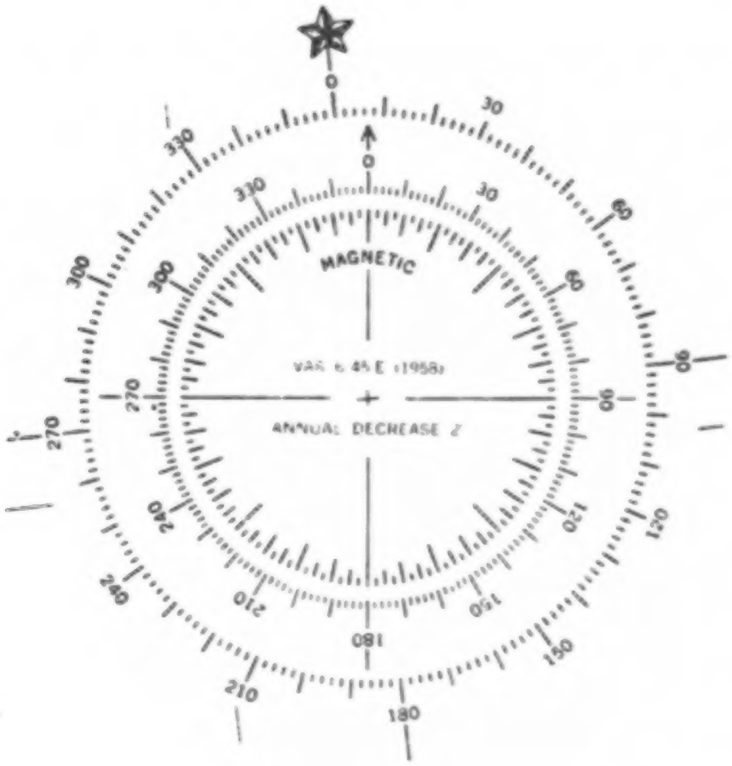


Figure 26

By means of the variation shown on the chart, he may accurately determine his compass error effected by the magnetism of the earth, and predicted at any given location. By means of his compass, the chart, he may be given time to locate himself and maintain his position. While seeing to the navigation of his vessel the mariner must also keep in mind his responsibility to other ships. He must keep a sharp lookout, and must observe practices, such as the sounding of fog signals, and keeping clear of traffic areas except when actually using these channels. He is responsible for his passengers, first, to other vessels, second, and to himself last. In keeping with this philosophy, we have the tradition of the captain always going down with his ship, or at least being the last to leave

2 OF 2

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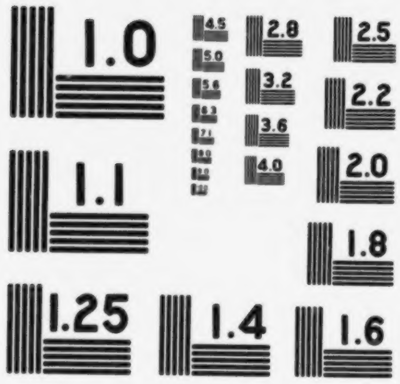
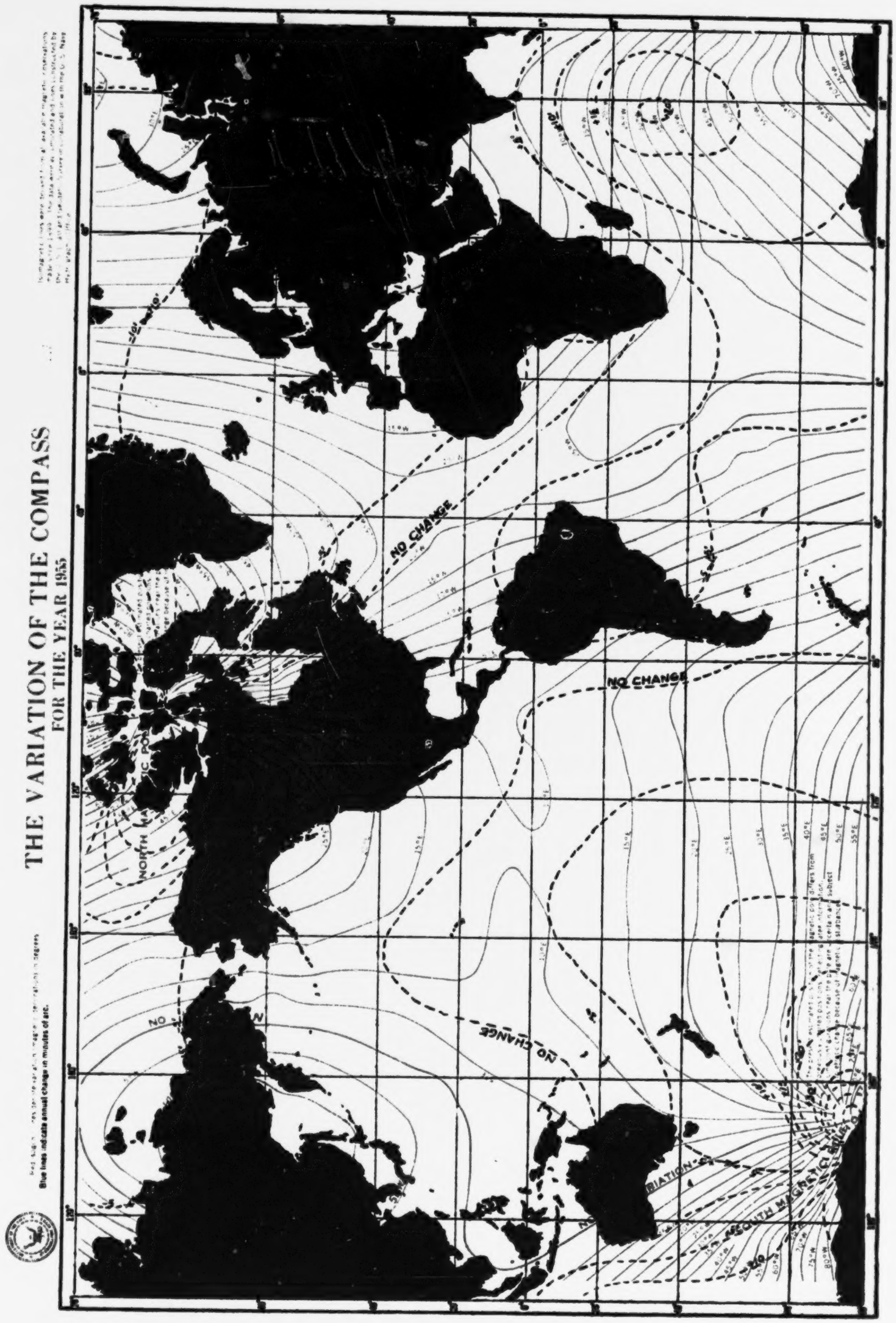


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963

his ship demonstrating his concern for the safety of others and the recognition of his responsibility to his passengers and his fellow mariners.



Variation. A simplification of H.O. Chart No. 1706.

Figure 27

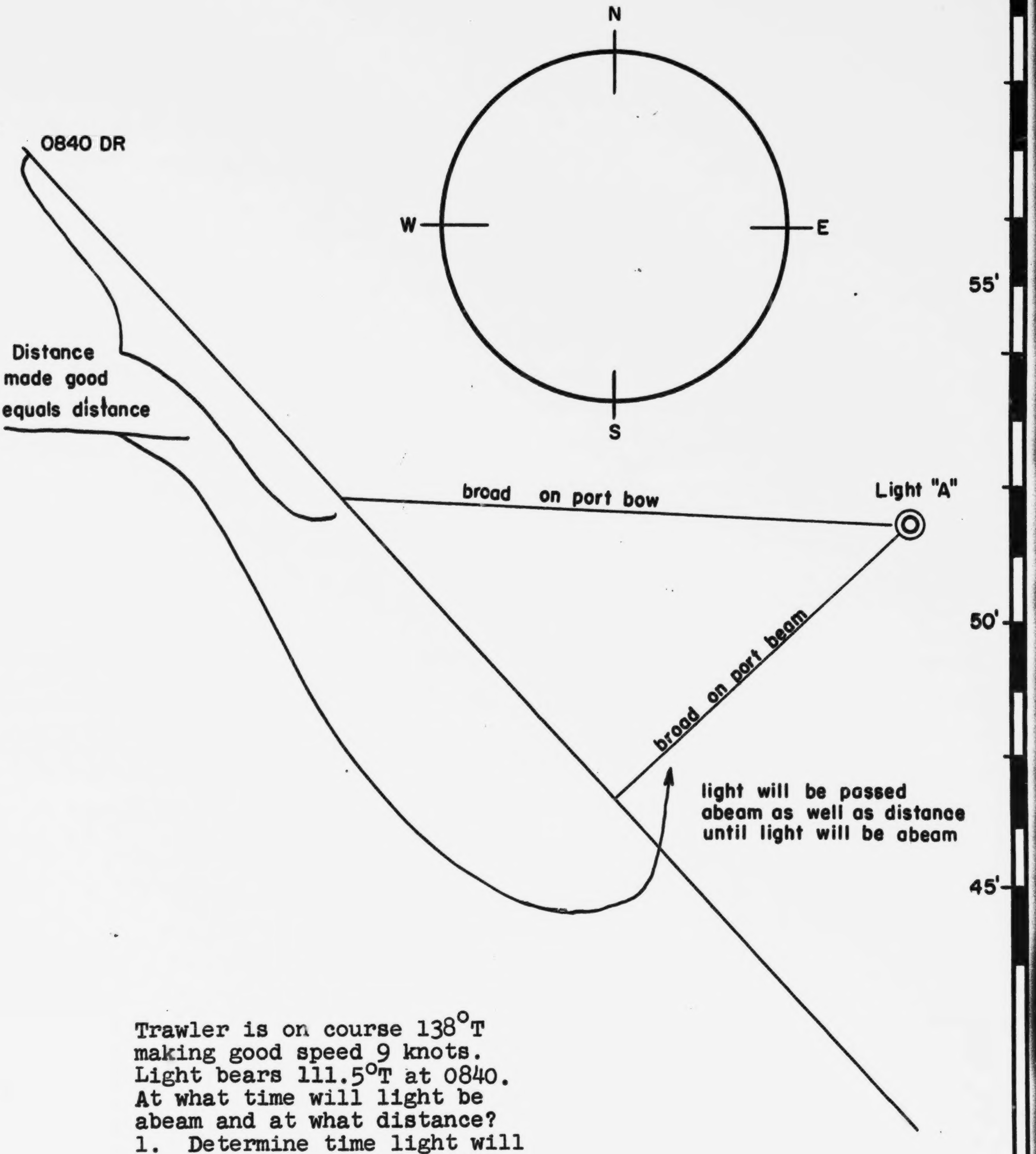
ASSIGNMENT I: LESSON 9

Specimen decklog

Date	Hour	Remarks
4/7	0900	wind NNW 5-8 Kn. Sea moderate
	0900	Took departure on "4" whistle bouy long 92°16'W lat. 29°05'N On course 095°T speed 12 knots
	______	Ship shoal light one point on starboard bow
	1355	Ship shoal light broad on starboard bow.
	1410	Ship shoal light abeam to starboard distance______ miles
	1500	Ship shoal light bearing 259°T
	2020	Southwest pass light two points on port bow
	2045	Southwest pass light broad on port bow
	2115	Southwest pass light abeam to port distance______ miles
	______	Changed course to 005°T
	2137	Whistle bouy abeam to port distance 500 yards
	2152	Passed SW pass light entering SW pass current ______ knots

Plot the track from the above log filling in all blanks.

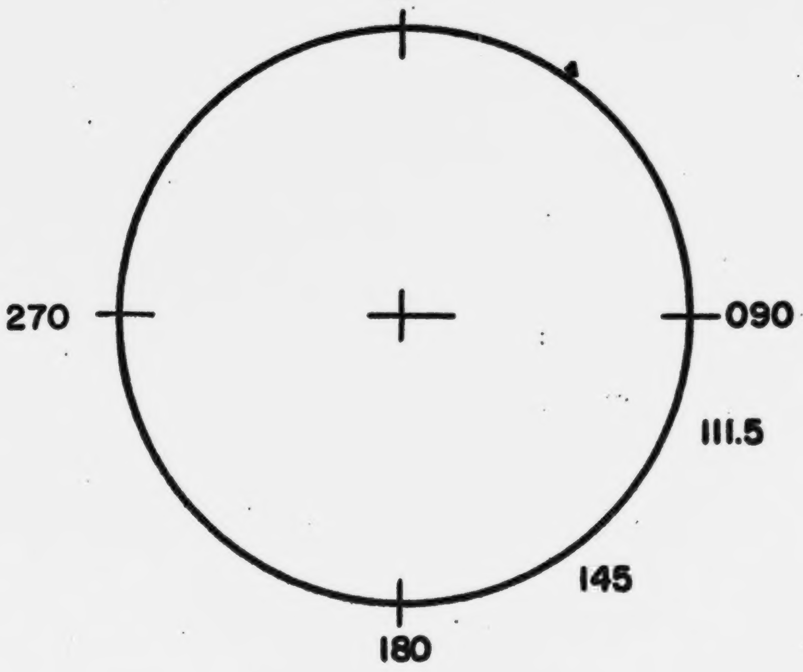
ASSIGNMENT II: LESSON 9


N
W
E
S
0840 DR
Distance made good equals distance
broad on port bow
Light "A"
broad on port beam
light will be passed abeam as well as distance until light will be abeam
38°
55'
50'
45'

Trawler is on course 138°T making good speed 9 knots. Light bears 111.5°T at 0840. At what time will light be abeam and at what distance?

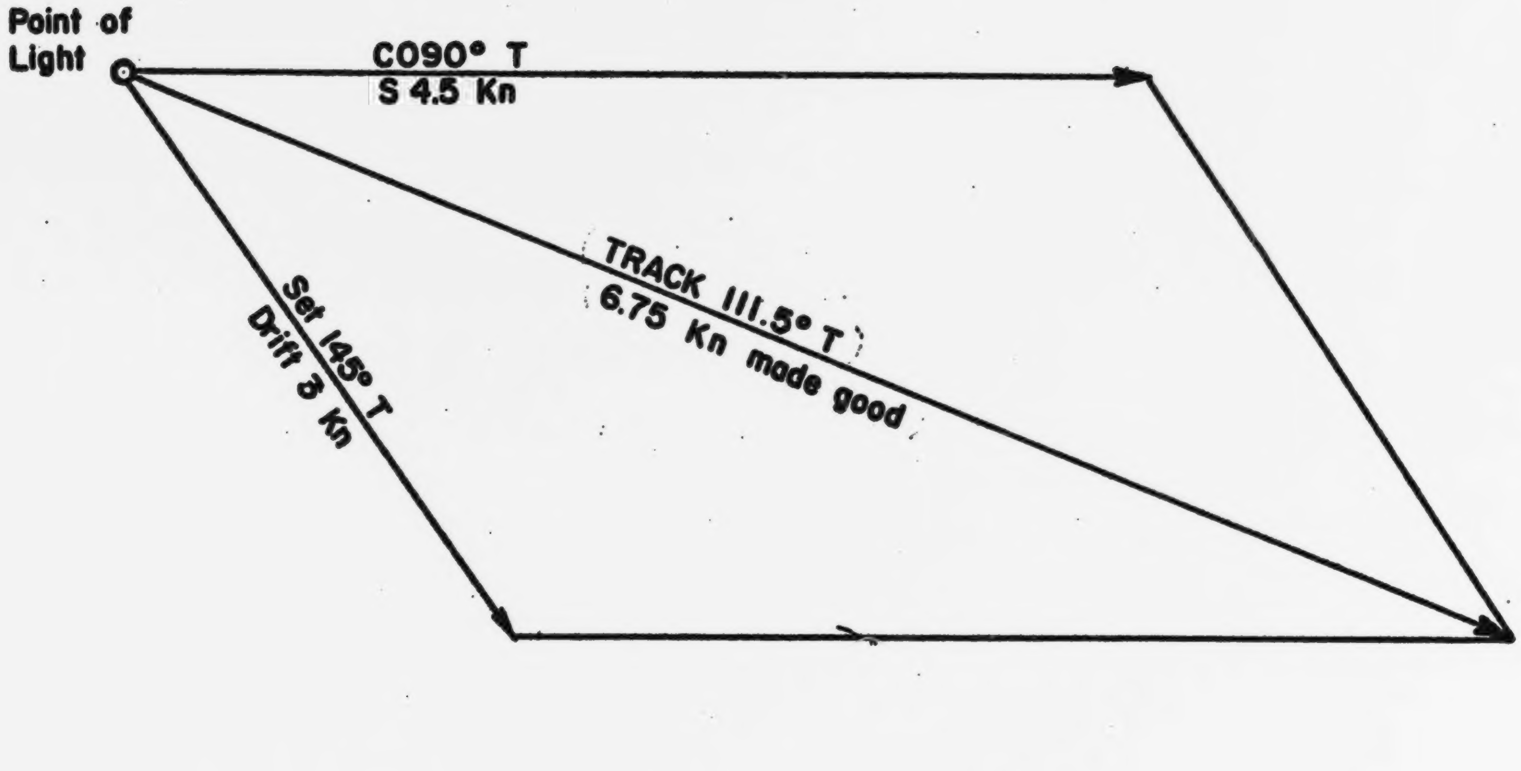
1. Determine time light will be abeam by noting time when light is broad at the bow.

ASSIGNMENT III: LESSON 9



A trawler is on course 090°T making engine RPM for 4.5 knots with trawl. Current is from NE by N at 3 knots.

1. Plot set and drift.
2. Complete parallelogram with course and speed vector.
3. Determine track and speed made good over the ground.



LESSON 10

NAVIGATION IN FOG AND OTHER CONDITIONS OF REDUCED VISIBILITY

During conditions of poor visibility such as might be caused by fog, the Navigator has grave responsibilities imposed to avoid collision with other vessels and to see to the safe navigation of his own vessel with respect to natural dangers to navigation. His work is more difficult because he cannot make observations or take bearings which would assist in fixing the ship's position and additional difficulty of seeing other vessels in time to avoid collision makes his job much more exacting. Fog signals are prescribed by the regulations and must be made by all vessels running in fog to warn others of their presence.

The responsibility of a captain to make fog signals during conditions of poor visibility cannot be over-emphasized. The usual sound producing instrument such as horn or whistle on a motorboat up to 65 feet in length should be used for making fog signals. However, the boat should carry some sort of hand or mouth fog horn for use in emergency. The requirement for producing a prolonged blast at intervals of no more than 1 minute under inland rules and 2 minutes under international rules must be borne in mind when selecting such equipment. For vessels at anchor or not underway, the rapid ringing of the ship's bell for 5 seconds at intervals of not more than one minute is prescribed both under inland and international rules. In making any signals in particularly fog signals, the operator must remember that his signal is only good as far as it can be heard and therefore, he must be sure that the signal he is making will carry as far as any other vessel which might prove a danger.

Next to fog signals, the most important consideration in the operation of a vessel under conditions of reduced visibility is certainly the safe operation of the vessel itself and this consideration involves two things; first, maintaining a safe speed consistant with the conditions of visibility and secondly maintaining proper lookouts. The small craft operator must take into consideration his stopping distance and adjust his speed so that he would be able to stop or at least manuever to avoid collision in any conceivable emergency. If two vessels are approaching one another, each making a speed of 10 knots, it must be remembered that their relative speed will be the sum of their individual speeds, or in other words, 20 knots. Due consideration must be given to this relative speed rather than the actual speed of one or the other vessel in maneuvering to avoid a collision. The operator must remember that his vessel maneuvers differently at different speeds and that a turn which is easy and smooth at one speed may be quite difficult at another speed. An understanding of the characteristics of his own vessel is absolutely necessary in the matter of stationing lookouts. It should be remembered that the lookout will have a physical advantage if his position in the vessel is as far forward and as high as possible. Frequently, fog will hang low on the water (particularly inland waters) and if the lookout is on the mast, he may be able to see quite clearly the masts of other vessels in his vicinity even though they are completely hidden by fog to an observer on the main deck. If the lookout is stationed on the bow, 30 feet forward of the helmsman, this simply means that in a fog he will be able to see 30 feet further ahead of the vessel than the helmsman can see. It must also be remembered that the watch must be kept in all directions, for although the greatest danger is ahead of the vessel underway in a fog, it is also true that other vessels might approach from any direction and this possibility must not be overlooked by the lookout on watch.

The navigator in terms of fixing his position is somewhat limited by conditions of poor visibility. However, if he knows his vessel's position at the time he enters a fog and maintains an accurate plot, there is no reason for experiencing any real difficulty. While the fog will deprive him of visual aids to navigation, he still has at his disposal the Depth Recorder (or lead line) and of course his compass. If the vessel is equipped with RDF of course it may be navigated with great accuracy fog or no fog.

It is advisable for the reason of lack of visual aids that the navigator keep an accurate plot at all times. If the navigator knows his vessels position at any given time as emphasized above, he has nothing to fear from sudden loss of visibility and once he is in a fog, he can maintain his plot by careful dead reckoning. The steering of exact courses with precise course changes at definite points is invaluable. If the navigator is familiar with a certain channel and knows how far he is supposed to run on a given course before changing, it is theoretically possible to negotiate such a channel even though visibility is very poor. At all times, careful note should be taken of currents, tides, prevailing winds, and other influences which might have to be taken into consideration when passing that same way again in a fog. The mariner can retrace his steps after a fog has set in if he has familiarized himself carefully with the intended track.

Navigation "on the bottom" in certain waters is extremely reliable. With a good chart and fathometer, the experienced seaman may use bottom contours to obtain fixes, particularly where such bottom contours are sharp and definite. He might, for example, know the time of crossing the 100 fathom curve and the distance run until the 200 fathom curve is crossed, or the 100 fathom curve is recrossed. He might follow a depth curve. For example, he might make his intended track conform to the 20 fathom curve, then as long as the fathometer does not deviate, he is "on course." Another method of using the bottom is to observe the rapidity with which the water will deepen or shoal on a given course, and compare this prediction with the actual depth readings experienced. The mariner can operate quite safely in fog or other conditions of poor visibility if he takes into consideration the following:

1. An accurate plot is necessary in order to know your position.
2. The Captain is responsible not only for his own vessel's safety, but also to consider the safety

of others and make proper signals.

3. The vessel that is not operated in a safe manner is always liable, both legally and morally.
4. A sharp lookout must be maintained at all times to avoid unexpected and undesirable surprises.

ASSIGNMENTS: LESSON 10

I. From the material found in Chapter 9 of Chapman's "Piloting,
Seamanship, and Small Boat Handling" make up a chart to be
posted in the wheel house for the use of the helmsman on watch
II. in making and recognizing fog signals. Include any and all
information you think might be necessary.

III. Assuming a stopping distance for your vessel of 200 yards at 10 knots and 100 yards at 6 knots, what would be a safe speed if visibility were:

(a) 1 mile
(b) ½ mile
(c) ¼ mile

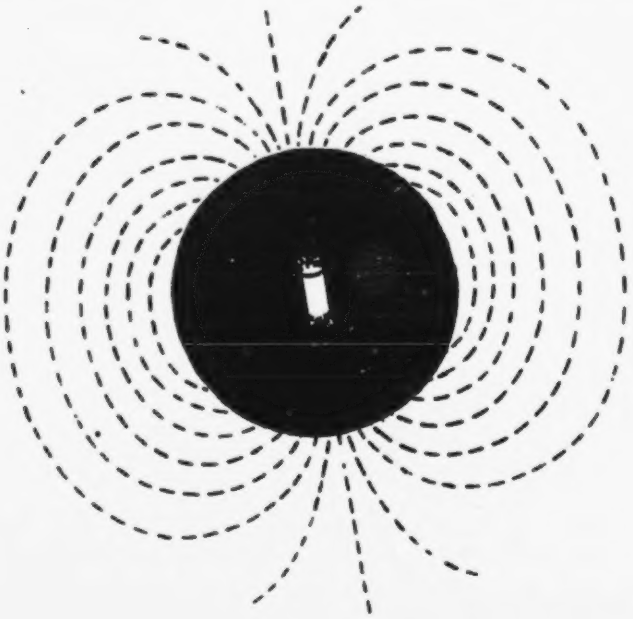
IV. If you were faced with the decision of whether to enter a fog bound harbor what factors would you take into consideration in determining your course of action? List all factors, keeping in mind that a given factor such as wind might be very important in one situation and of no consequency in another.

PART III THE MARINE COMPASS AND PILOTING

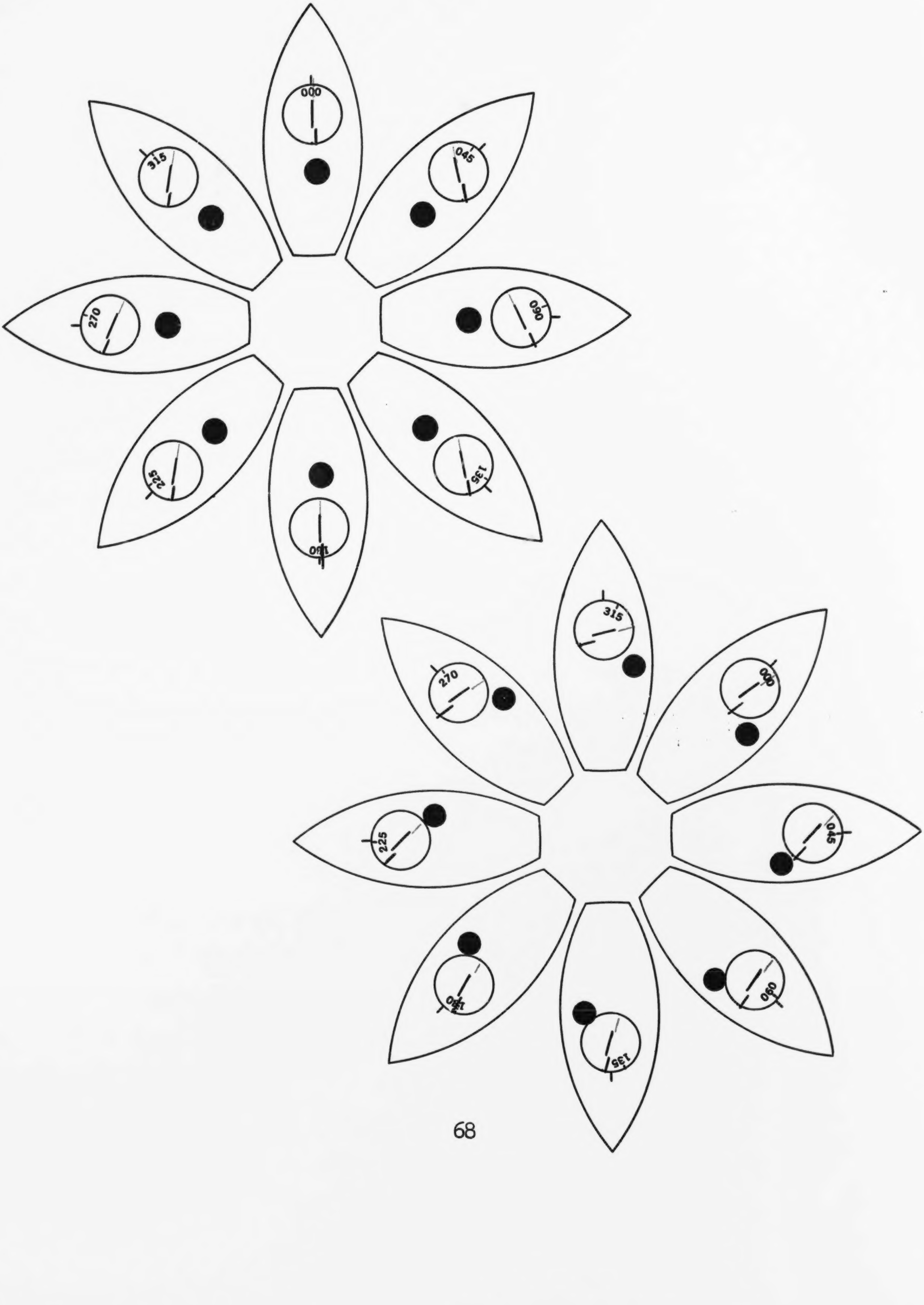
LESSON 11

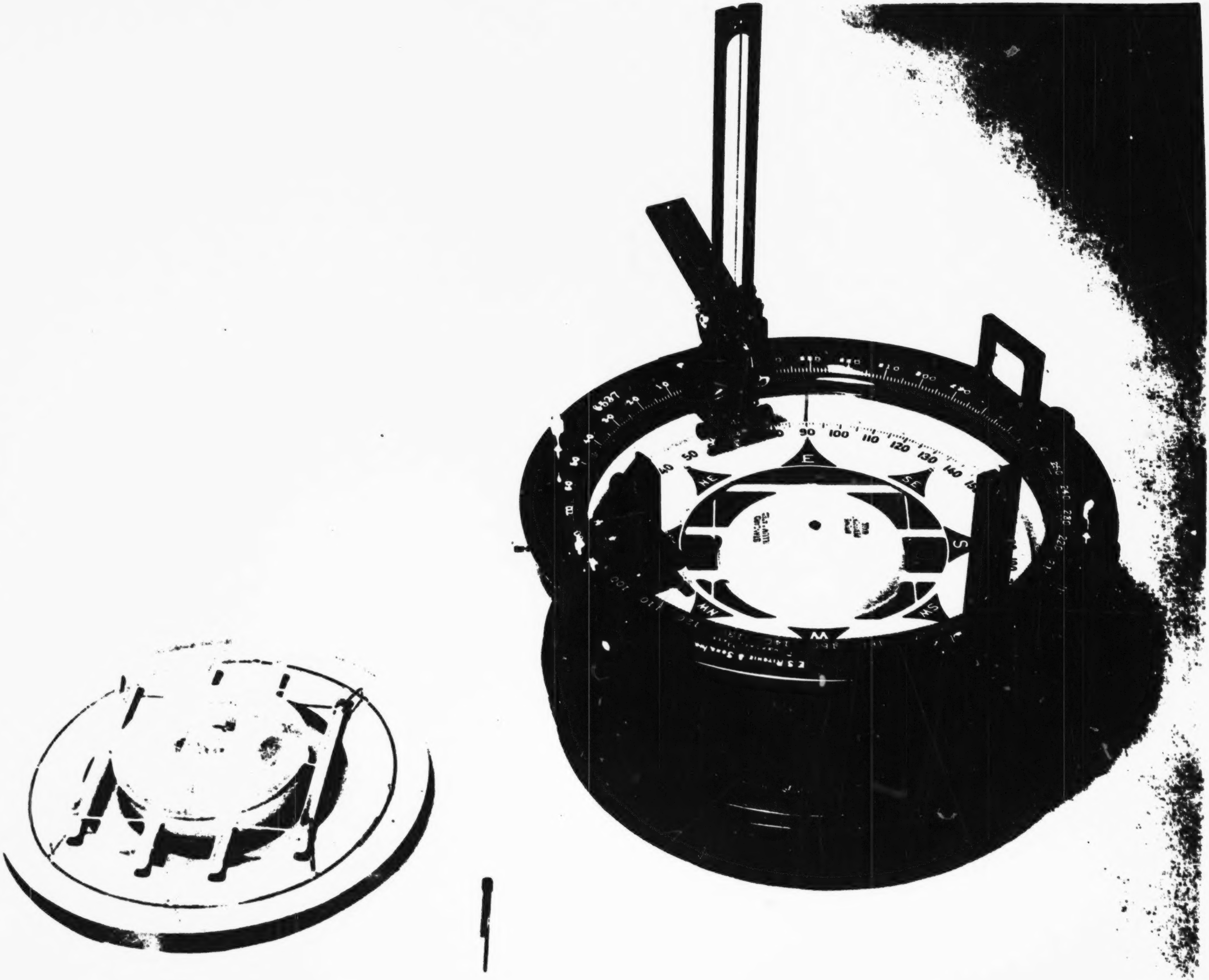
HISTORICAL BACKGROUND AND CONSTRUCTION

Possibly the most widely used instruments and the simplest of all navigation instruments is the marine compass, it depends on its operation on a very common phenomena known as magnetism. The compass is one of the oldest of navigational instruments following the quadrant which was evolved when man first began to get out of sight of land. The early instruments were crude but effective because they depended upon a constant phenomena, that is the earth's magnetic field. It is as if the earth were a giant magnet. The way in which the earth effects a compass needle is the way in which the one magnet effects another. Of course there are other factors involved in the earth's magnetic field besides the true magnetism of the North and South poles. For instance, there are in some areas of the world large deposits of iron beneath the surface of the earth and beneath the surface of the sea. These deposits of iron affect the compass, and bend the compass needle when we sail in these areas so that it no longer points to true North, as a matter of fact there are few places on the earth surface where the compass does point to true North. An examination of the compass rose shown in Figure 26 shows that the compass actually points 12° West of true North, for the particular latitude and seasons, when this compass rose was made. On any given chart the compass rose may be seen, for example on chart 1116, South of Cameron we see a compass rose which indicates a difference between magnetic North and true North of 7° and 30 minutes to the east. This difference is called variation. A chart showing the magnetic variation over the entire surface of the earth is given in Figure 27. It will be seen from this chart that the South magnetic pole is located South of Australia. It will be seen that there is a line of no variation, or a line along which the compass points to true North which passes through North and South America cuts across Cuba and Jamaica, and follows the east coast line of Florida, so if you are sailing in the vicinity of Jacksonville, Daytona, or Miami Florida your magnetic compass should point to true North. Sometimes the compass will be deviated, or thrown off, by iron or other influences in the vessel itself. This compass error is called deviation. Deviation is error in the compass due to the magnetism of the boat itself. In order to understand these errors we should familarize ourselves with magnetism itself, and how it operates. We have already said that this magnetism is as if the earth were a magnet and if we imagine a magnet as the earth's core and draw lines representing the forces of this magnet we get a picture like that shown in Figure 28.



—The magnetic field of the earth. Figure 28

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NE
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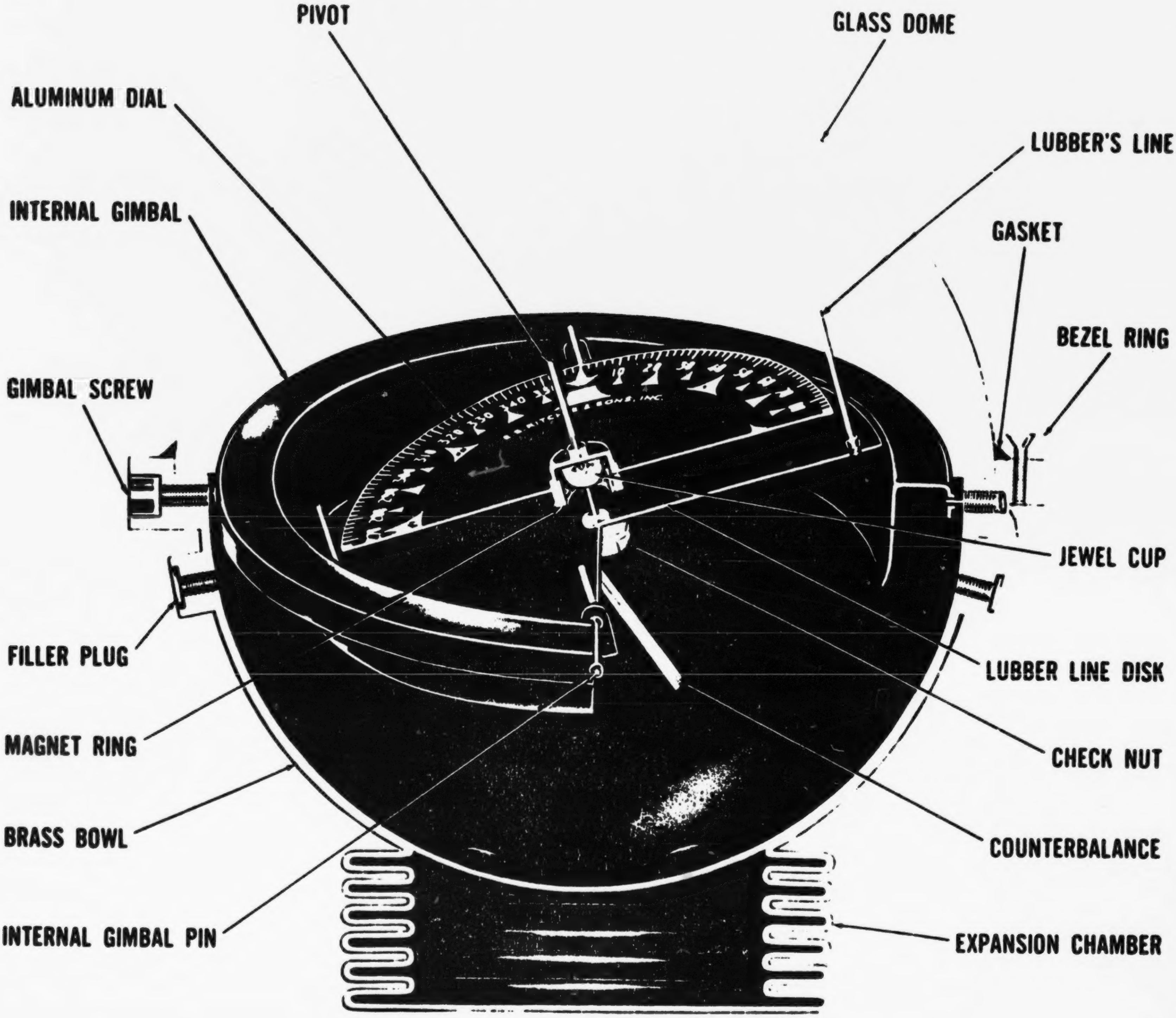


CUTAWAY VIEW OF "GLOBE MASTER" COMPASS

E. S. RITCHIE & SONS. INC.
PEMBROKE, MASS.

ASSIGNMENTS: LESSON 11

I. Look up the magnetic variation for the following locations:

- a. New Orleans, Louisiana
- b. Galveston, Texas
- c. Miami, Florida
- d. Key West, Florida
- e. Havana, Cuba
- f. Charleston, South Carolina
- g. Chicago, Illinois
- h. Boston, Massachusetts
- i. Portland, Oregon
- j. Los Angeles, California

II. Box the compass

III. Give the reciprocal of bearings of the following

- a. 90°
- b. 210°
- c. 45°
- d. 65°
- e. 300°
- f. 325°
- g. 360°
- h. 100°
- i. 165°
- j. 25°

LESSON 12

MAGNETISM

Figure 28 shows a picture of the magnetic field of the earth, drawn as if there were in the center of the earth a magnetic force. These lines that we see around the picture of the earth here are lines of magnetic force and any magnet, such as a compass needle placed in this field would line up with these lines of magnetic force. We see then that the compass needle at the North pole should point straight down, of course it can't point straight down because it is balanced or floating and is held in a horizontal position by the liquid in which it floats or by a pinion on which it is balanced, so the compass would not know which way to point at the North pole and would probably spin eradically. However, in our latitude here in the Gulf of Mexico the horizontal force on the compass is very strong, because as we can see in this illustration, Figure 28, the lines of force are almost parallel with the earth's surface and so they pull very strongly in a horizontal direction on the compass needle. Magnetism works in such a way that the North pole of the magnet is attracted to the South pole of any other magnet, so we must understand that, the end of the compass needle which is labeled North, is the end which points to the North, but it is actually and really the South pole of that magnetic needle, so the south end of the magnet points to North pole of the earth. For convenience in navigating we label the South pole of the magnetic compass, not with its name, but rather with the direction in which it points, so we say that the compass indicates North. If two magnets were placed side by side their South poles would repel each other, and their North poles would repel each other. If we switch them to be attracted to one another, we must place them, so that the North pole of each is close to the South pole of the other.

Figure 29, shows a common type compass. This compass is installed in a box, and an instrument such as a sighting vane may be mounted on top of it. The advantage is that this type compass installation is portable, every vessel should be equipped with one of these instruments for taking bearings with the permanently installed compass used for

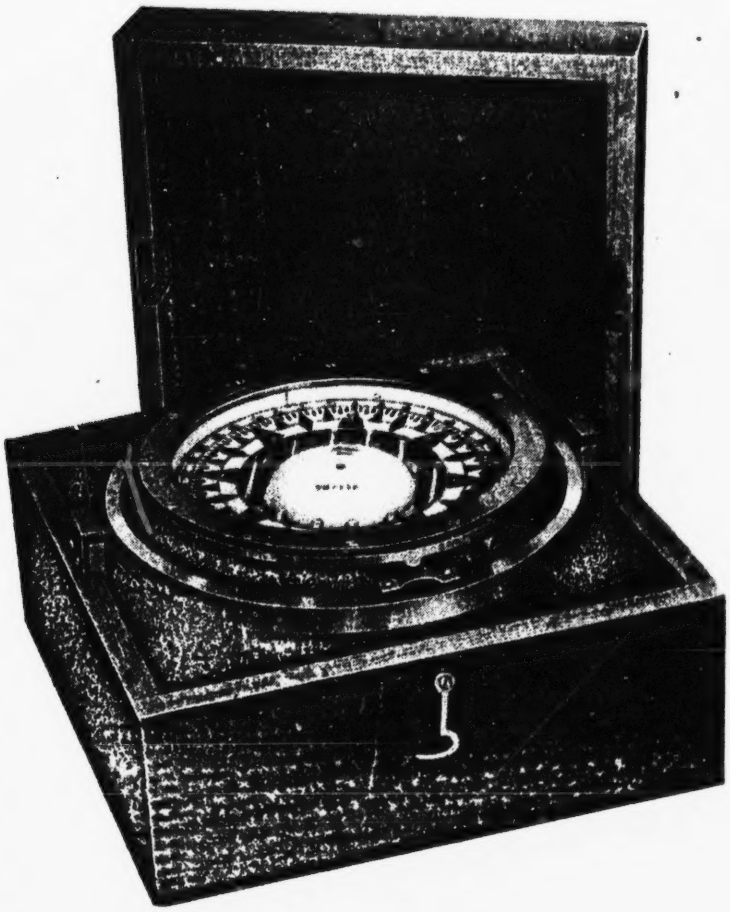


Figure 29

steering, such a compass is seen in Figure 30.

Figure 30, is the standard 7 1/2 inch Navy compass, these may be frequently purchased through some surplus agency or direct from a manufacturer. In general they are very dependable instruments, especially when mounted in a binnacle.

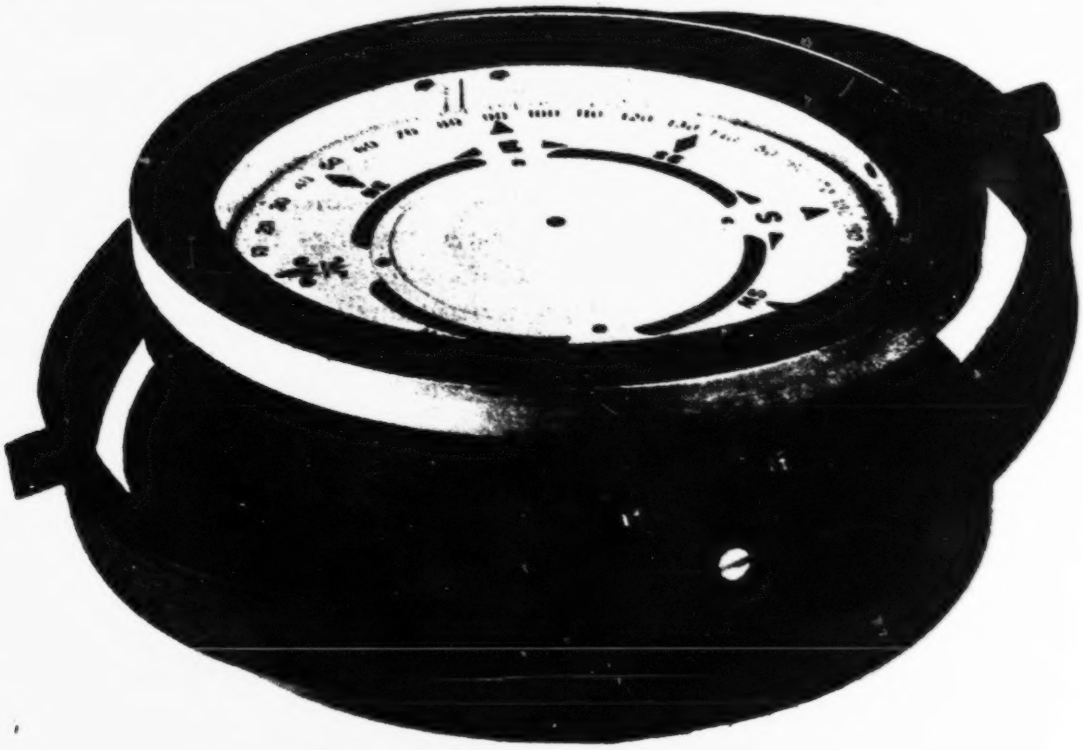


Figure 30

Another type compass is shown in Figure 31. This is a smaller compass, and is covered by a glass hemispherical top through which the compass can be read with ease.

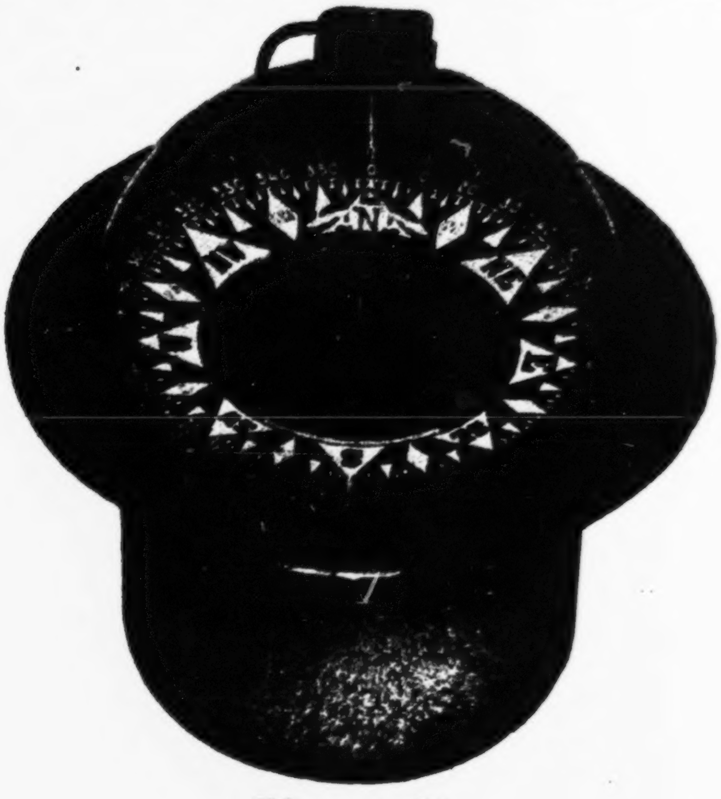


Figure 31

ASSIGNMENTS: LESSON 12

I. Made a drawing similar to Figure 28 showing angle of dip at:

   a. Panama Canal

   b. New Orleans, Louisiana

   c. New York, New York

II. Demonstrate magnetic repulsion and attraction with two bar magnets.

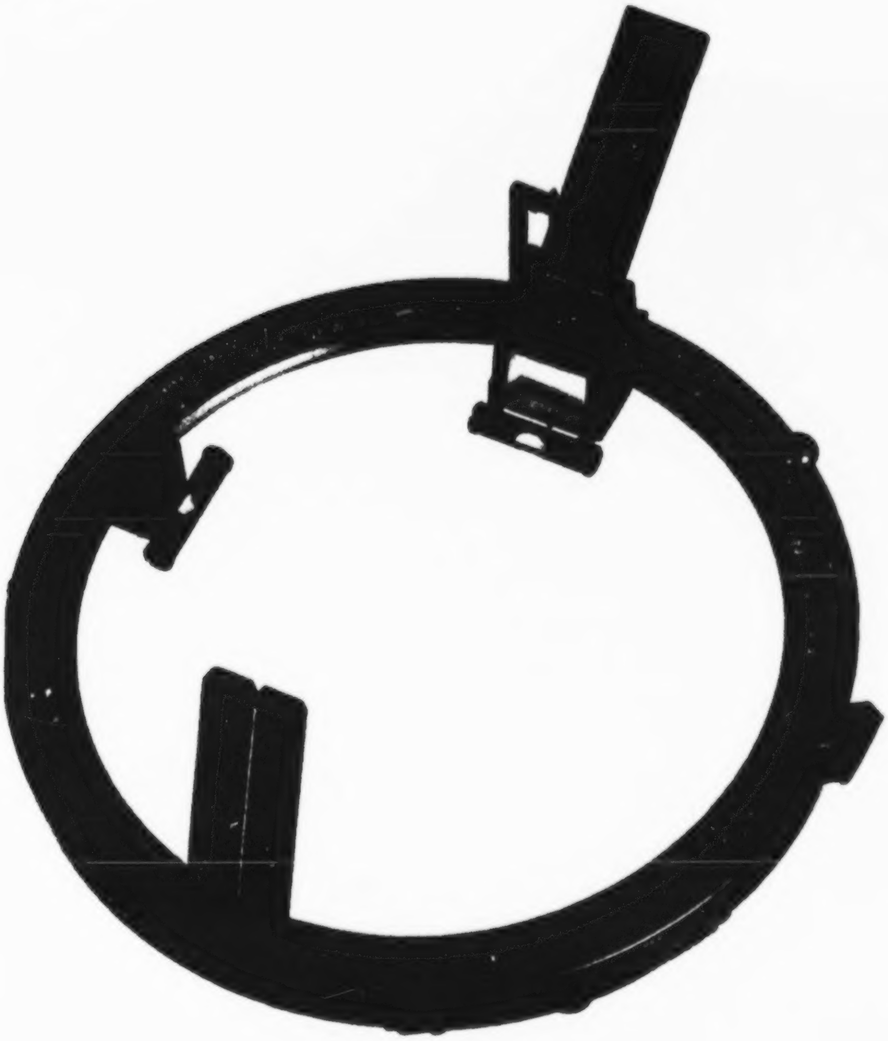
III. Using the bar magnet and a compass identify the north pole of the bar magnet and label it.

IV. Now using the bar magnet whose north pole has been identified; determine the north pole of another magnet.

LESSON 13

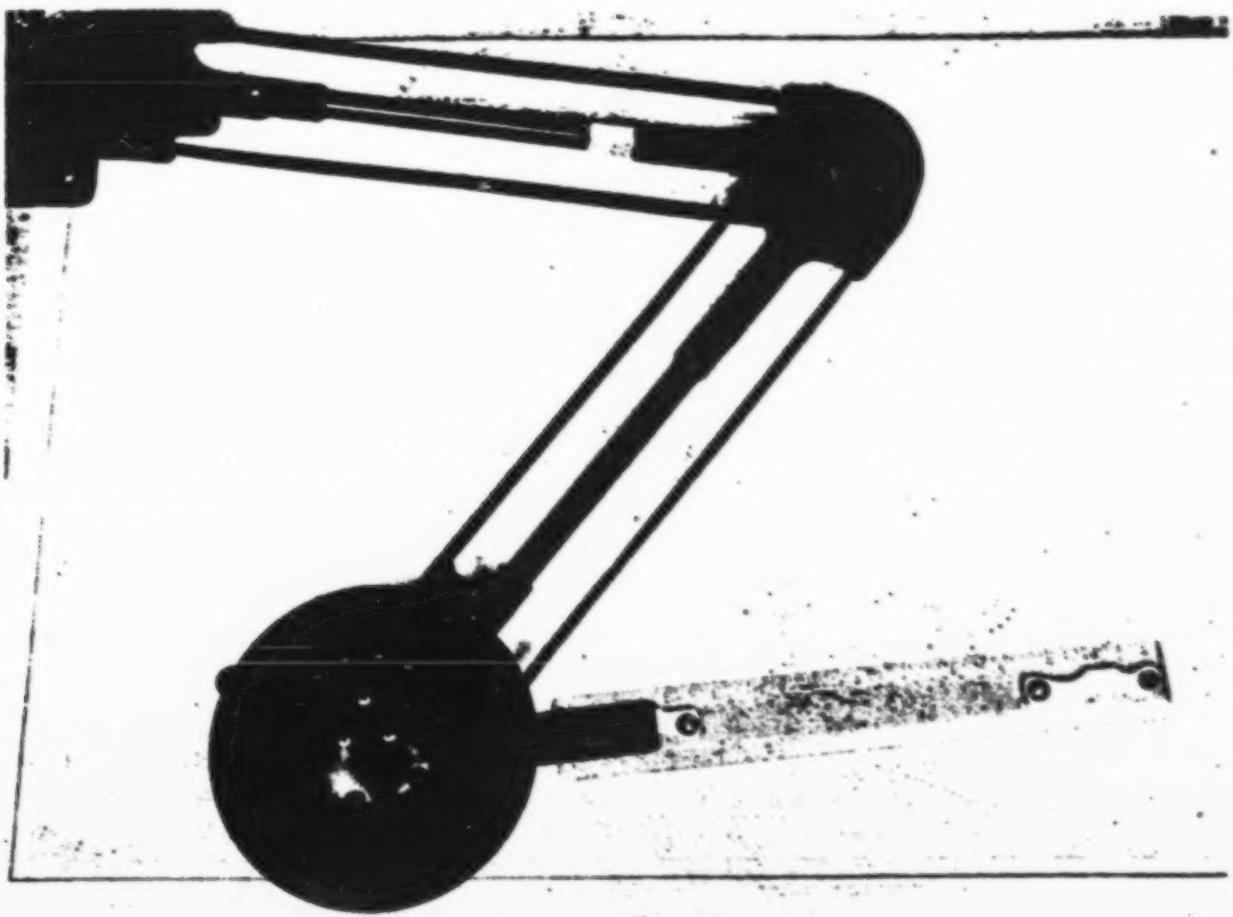
COMPASS ERROR

The sighting vane or azimuth circle, which is shown in Figure 32, is a desirable addition to the mariners kit. This particular sighting vane is designed to fit the type compass shown in Figure 30. If such a compass could be mounted for steering, in the wheel house of a trawler, forward and high enough so that the navigator could sight across its face, through the wheel house windows, then the azimuth circle could be used very well for taking bearings, and for plotting courses. In using the compass for laying out courses, for steering, and for taking bearings, the navigator must know his exact compass error.



—An azimuth circle.

Figure 32



—Drafting machine.

Figure 33

Figure 33 shows one type drafting machine which greatly speeds up the job of laying out courses and brings on the chart.

As mentioned before this compass error is in two parts, that is, variation and deviation. Variation due to the earth's magnetic field, is found on the chart. This variation applies to the particular location in which the ship is located. Deviation on the other hand, is caused by metal in the ship itself, and is the same for a given ship no matter where he is sailing, however, it will be found that deviation changes while the ship changes heading. Deviation may be determined in advance and plotted in a diagram or table, and because deviation remains relatively constant for a given vessel this diagram will be useful for a long period of time. Deviation of course, should be checked after every repair period or layup, because work on the engine or wrenches or other metal equipment about the vessel may alter the deviation characteristics of the ship. A deviation table which may be used to show this compass error is shown in Figure 34.

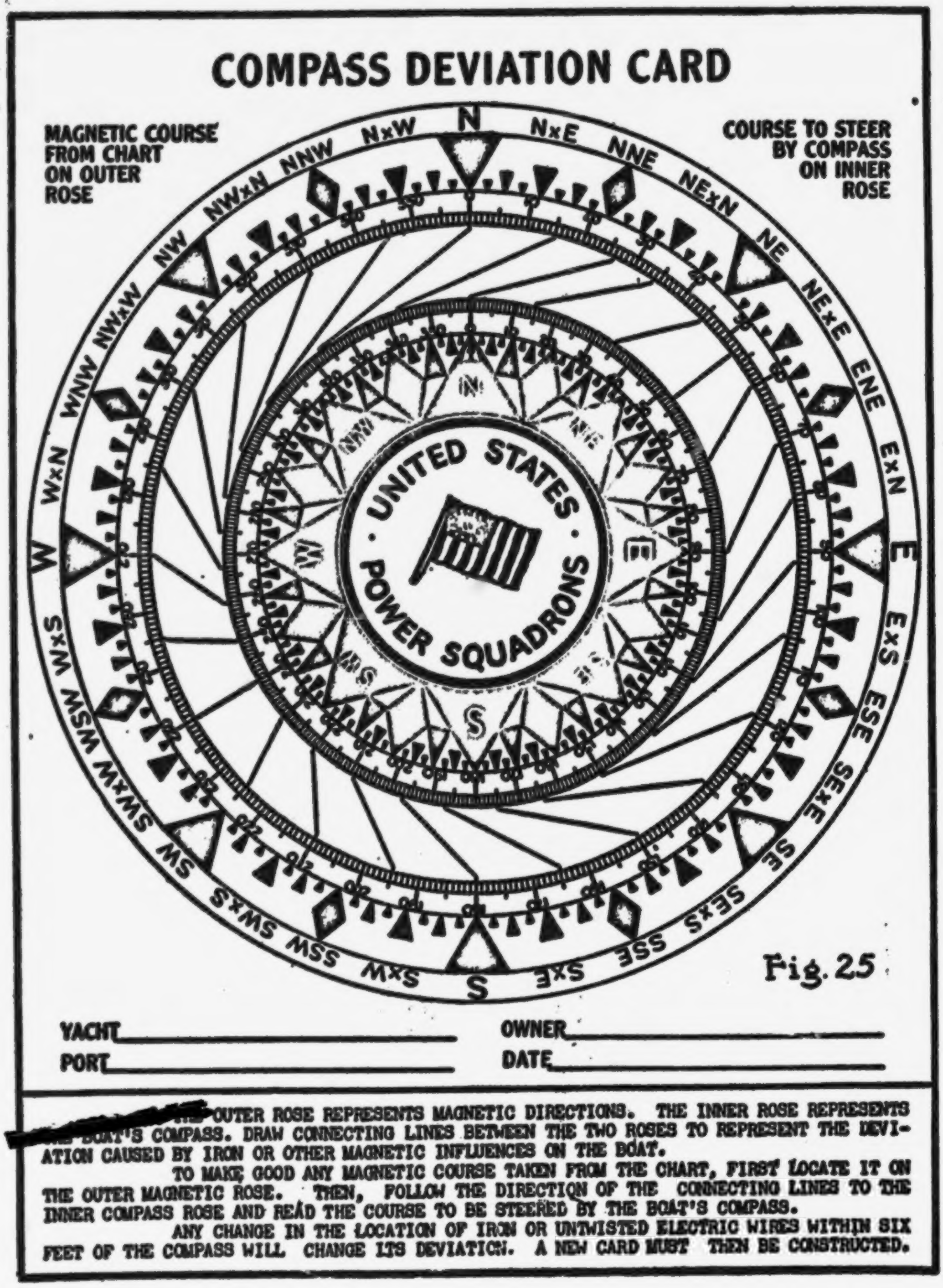
DEVIATION TABLE
FIG. 5

Ship's Head P.S.C.	Dev.	Ship's Head P.S.C.	Dev.	Ship's Head P.S.C.	Dev.
0°	14° W.	120°	15° E.	240°	4° E.
15°	10° W.	135°	16° E.	255°	1° W.
30°	5° W.	150°	12° E.	270°	7° W.
45°	1° W.	165°	13° E.	285°	12° W.
60°	2° E.	180°	14° E.	300°	15° W.
75°	5° E.	195°	14° E.	315°	19° W.
90°	7° E.	210°	12° E	330°	19° W.
105°	9° E.	225°	9° E.	345°	17° W.
				360°	14° W.

Figure 34

Figure 34 shows a type table that is very easy to construct and will serve for most cases. If the navigator prefers, he may use a compass diagram such as that shown in Figure 35, known as the compass deviation card or a curve of deviations card, known as the Napier diagram which is shown in Figure 36. A discussion of the construction of this diagram may be found in the text, or in Bowditch; American Practical

Navigator. For all practical intentions and purposes, however, the compass deviation card or table which is shown in Figure 34, will be adequate.



COMPASS DEVIATION CARD

MAGNETIC COURSE FROM CHART ON OUTER ROSE

COURSE TO STEER BY COMPASS ON INNER ROSE

Fig. 25

YACHT______________ OWNER______________

PORT______________ DATE______________

[redacted] OUTER ROSE REPRESENTS MAGNETIC DIRECTIONS. THE INNER ROSE REPRESENTS BOAT'S COMPASS. DRAW CONNECTING LINES BETWEEN THE TWO ROSES TO REPRESENT THE DEVIATION CAUSED BY IRON OR OTHER MAGNETIC INFLUENCES ON THE BOAT.

TO MAKE GOOD ANY MAGNETIC COURSE TAKEN FROM THE CHART, FIRST LOCATE IT ON THE OUTER MAGNETIC ROSE. THEN, FOLLOW THE DIRECTION OF THE CONNECTING LINES TO THE INNER COMPASS ROSE AND READ THE COURSE TO BE STEERED BY THE BOAT'S COMPASS.

ANY CHANGE IN THE LOCATION OF IRON OR UNTWISTED ELECTRIC WIRES WITHIN SIX FEET OF THE COMPASS WILL CHANGE ITS DEVIATION. A NEW CARD MUST THEN BE CONSTRUCTED.

Figure 35

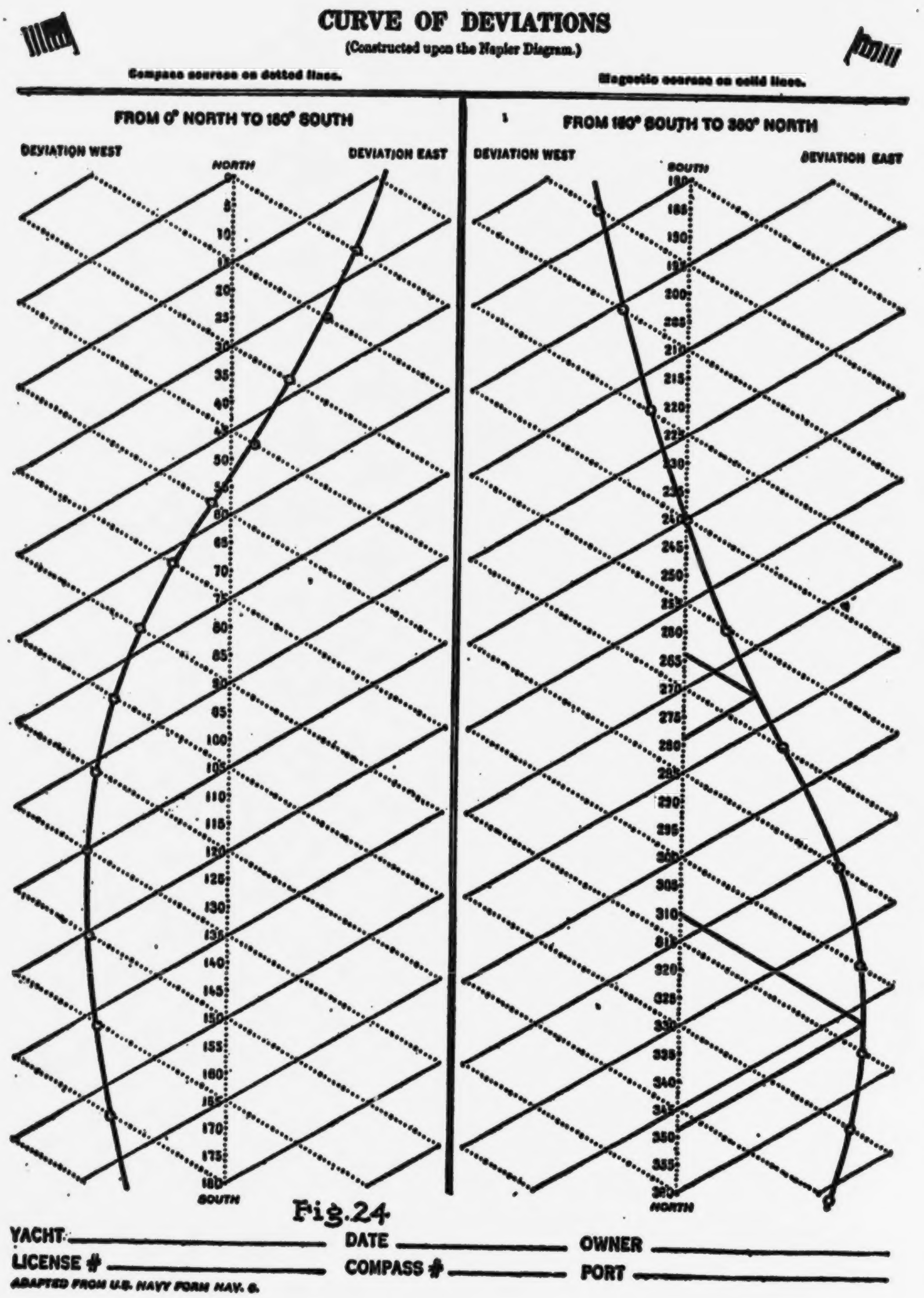

CURVE OF DEVIATIONS
(Constructed upon the Napier Diagram.)
Compass courses on dotted lines.
Magnetic courses on solid lines.
FROM 0° NORTH TO 180° SOUTH
FROM 180° SOUTH TO 360° NORTH
DEVIATION WEST
DEVIATION EAST
DEVIATION WEST
DEVIATION EAST
NORTH
SOUTH
SOUTH
NORTH
Fig.24
YACHT
DATE
OWNER
LICENSE #
COMPASS #
PORT
ADAPTED FROM U.S. NAVY FORM NAV. 6.

Figure 36

In finding the deviation, several methods of procedure may be employed, in one case the bearings of a distant object may be used. In another case the bearings of a celestial body, such as the sun or a star may be used, possibly the simplest method is to take bearings on a distant object such as a buoy. This procedure is known as swinging ship. The navigator places his ship at some distant from the light house, buoy, or other land mark and turns the ship in a small circle, taking bearings on this object as he goes around. These bearings are plotted on a card, and later compared. He may then construct a deviation table such as shown in Figure 34, which will give him the error for any given heading. The error is applicable very simply, and a simple rule of application can be used by the navigator. The simplest procedures, in correcting the compass, that is, going from a compass reading to the true reading is as follows: No. 1, correct easterly errors clock wise. In other words if the compass error is east whether it be deviation or variation, then you go clock wise around the compass card to get the true heading. No. 2, Correct westerly errors counter clock wise. In other words if the error is named west, whether it be variation or deviation you go in a counter clock wise direction around the card. So we see on examining the card that if we have a westerly error of 5° in the compass and we wish to correct the compass then we go in a counter clock wise direction with that westerly error to get the true heading. We are realizing of course that westerly error means simply that the compass points west of the true heading. If we are speaking of variation then we mean that magnetic North lies West of true North. If we are speaking of deviation then we mean that the compasses North lies West of the magnetic North.

Possibly the simplest way to determine magnetic error is to note the heading of the ship at a given time and read the compass. For example, if we are traveling in a channel we can look at the chart and find the true bearing of the channel. If we find that the channel in which we are steaming has a bearing of 170 then we read the compass and find the compass is reading 173 then we know that we have an error to the west of 3° from the compass reading. To obtain the true course we must subtract 3° from the compass reading. We may write this down on the compass card and then whenever we are steering such a course, 170 or whenever we desire to steer such a course 170 we know from this experience in the channel that we must steer 173 in order to make good 170. To take a further example, lets suppose that we are steaming in a channel which lies east and west, we are going west so the compass should read 270. Lets suppose that we read the compass and we find it to read 260, then we may write that down and know that in subsequent experiences if we desire to steer a course of 270 we must make the compass read 260, because we have an error on that particular heading minus 10°. Usually the mariner will find it more convenient to use plus and minus errors than East and West errors. He may wish to construct his compass card or deviation table in that way rather than as shown in Figure 34, that is, instead of saying he has a 14° westerly error on a North heading as shown in Figure 34, he would say "my error on a North heading is minus 14°", instead of saying he has a 5° Easterly error on a heading of 75°, he would say, "my error on 75° is plus 5°". In a series of experiments along this line, that is noting the compass error on several known courses such as, running in the Intercoastal canal or running in a channel from a sea buoy, the navigator can collect enough information to draw up a compass card such as a Napier diagram shown in Figure 36, a deviation card shown in Figure 35, or construct a table as shown in Figure 34, which will assist him in steering any desired course, at any given time. He should be careful in collecting this information that he does not read the compass at a time when he is passing near a power line, submarine cable, bridge, or other objects which might cause the compass to take on an unnatural error, however, if the navigator is careful to avoid such things when he takes his compass reading he can obtain accurate information which will enable him to steer an accurate course anywhere in the sea.

It is important to know the compass error, because without such a knowledge the navigator cannot steer an accurate course, he cannot take accurate bearings, he cannot accurately determine the position of his vessel at any given time.

Accurate knowledge of the vessels position is absolutely necessary if the navigator is going to be able to calculate such important things as fuel consumption, time of arrival, and other items of information which are necessary to have in order to plot his course in bad weather and conditions of poor visibility. If the navigator is running along on a given track and the weather closes in so that visibility is reduced, he is lost unless he has accurate knowledge of his position at the time that the weather closed in. If he does have this knowledge then he can proceed cautiously and pick up a buoy or other land marks which will guide him on into a safe anchorage.

ASSIGNMENTS: LESSON 13

I. Which way will the compass needle be deflected by magnetic variation if the ship is in:

a. New York, New York

b. Tacoma, Washington

Explain why this takes place

II. If the ship has been built on a North magnetic heading which way (E or W) will the compass be deviated when the ship is an (a) an easterly course? (b) on a westerly course?

III. Box the compass.

IV. Describe the procedure you would follow to plot a curve of deviation for a new compass.

V. What is a reciprocal bearing? How may reciprocal bearings be used to determine compass error?

ASSIGNMENTS: LESSON 14

PRACTICAL WORK IN APPLICATION OF COMPASS ERROR

When the navigator prepares for a cruise, he must take into consideration several things in logical order; first, the intended track is laid out on the chart. This track shows the path that the vessel should follow and considers safety and ease of navigation taking full advantage of aids along the way, secondly, the navigator calculates what courses to steer and for how long a course must be held at a given speed to make good the intended track. One of the prime considerations at this point is compass error.

Using the magnetic variations given on the chart and his deviation card or table, the navigator can predetermine courses to be steered.

1. Determine compass error in each of the following cases:

heading (T)	Compass reads	Error (East or West)
(a) 316°	314°	______
(b) 295°	290°	______
(c) 180°	182°	______
(d) 090°	091°	______
(e) 035°	033°	______
(f) 270°	220°	______
(g) 000°	002°	______

2. In each of the above cases, what would deviation be if variation is: (a) (b) (c) (d) (e) (f) (g)

7° W
6° E
2° E
1° W
15° W
3° W

PROBLEMS

Chart 881

Describe lights

(a) N W point of Avoca Island

(b) S W point of Tiger Island

(c) Southern end of Berwick Locks

Measure Distance

(a) Light "a" above to light B

(b) Light "b" above to light C

Chart 1050

(a) Describe light characteristics of Beacon 7 and of Eugene Island Lighthouse.

Chart 1116

(a) Describe light characteristics of Shipshoal lighthouse

(1) How far is it visible

(2) How much water is in

(3) What is the distance from Shipshoal light to to Beacon 7?

What is the latitude and longitude of

(1) Beacon 7

(2) Eugene Island lighthouse

(3) Trinity Shoal Buoy

What is the course (magnetic) and distance from:

(1) Beacon 7 to Trinity Shoal.

(2) Trinity Shoal to Sabine Bank lighthouse

(3) Shipshoal buoy to 49 F lump in 28° 1.5'N & 91° 28.5' W

PROBLEMS IN PLOTTING

Tools: Parallel Rules and Dividers
Material: Speed-time-distance table, Plotting sheet No. 1.

1. Plotting Positions

Following are four problems in plotting positions by Latitude and Longitude. Plot the positions carefully as they will be used as reference points in following problems. Use standard symbols for buoys and platforms as given on USC&GS charts. The dot below the diamond in the buoy symbol and the center of the square in the platform symbol are the exact points of location.

(1a) Plot buoy "A" in 29° 22.0' N. Lat., 91° 18.9' W. Long.

(1b) Plot buoy "B" in 29° 25.5' N. Lat., 91° 10.0' W. Long.

(1c) Plot buoy "C" in 29° 05.5' N. Lat., 91° 04.3' W. Long.

(1d) Plot oil well platform in 28° 43.0' N. Lat., 90° 45.9' W. Long.

2. Courses and Distance

The following problems are given for plotting courses and measuring distances. The compass rose on the plotting sheet is oriented true North so courses plotted are TRUE. Magnetic courses are obtained by subtracting the given Variation from the true course.

(2a) Plot course and measure distance from buoy "A" to "B".

______________cse true____________cse mag____________miles

(2b) Plot course and measure distance from buoy "B" to "C".

______________cse true____________cse mag____________miles

(2c) Plot course and measure distance from bjoy "C" to oil well platform ("d" above)

______________cse true____________cse mag____________miles

3. Dead Reckoning

The following ficticious situations are intended to give practice in speed-time-distance, course plotting and bearing plotting. The buoys and platform referred to are the ones plotted in problem 1.

(3a) The M/V *Lark* is located in 29° 20.5' N. Lat., 90° 48.5' W. Long. when a distress call from a vessel in 29° 01.0' N. Lat., 90° 57.5' W. Long. is heard. Plot course and distance to vessel in distress, and if speed is 12 knots, compute the time required to make the run.

__________cse true__________cse mag__________miles___hr___min.

(3b) Tug *Ajax* is running course 162° true at speed 8 knots for oil well platform in 28° 43.0' N. Lat., 90° 45.9' W. Long. At 0800, buoy "A" is sighted bearing 207° true and buoy "B" is bearing 117° true. What is the position of the Ajax at 0800?

_______________N. Lat._______________W. Long.

What should course be changed to run for platform?

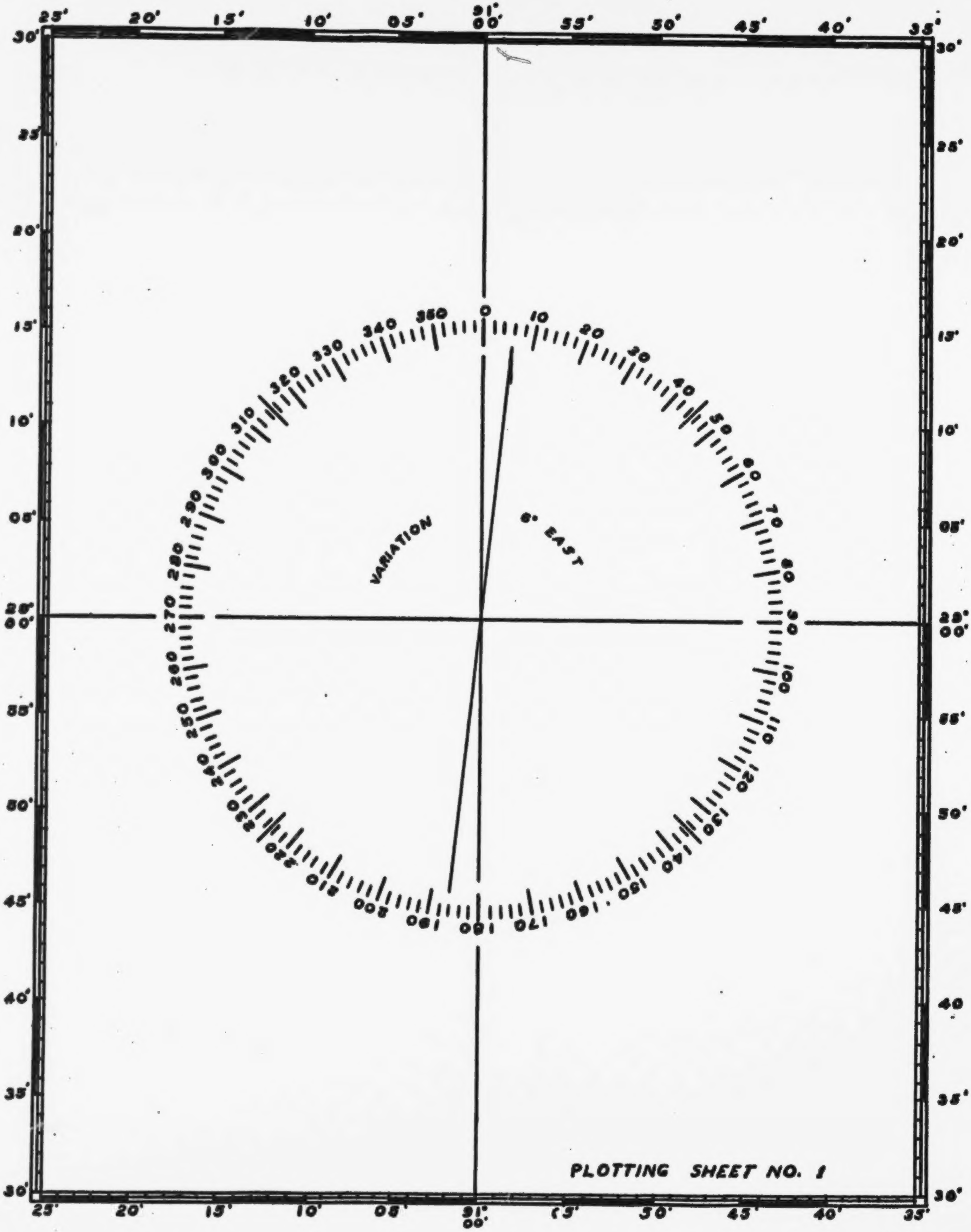
_______________cse true_______________cse mag.

The *Ajax* continues on her new course and at 1030 buoy "C" is sighted dead ahead about four miles off. At 1100, *Ajax* is along side buoy "C", what is new course to platform?

_______________cse true_______________cse mag.

What is the estimated time of arrival at the platform?

_______________hours.



PLOTTING SHEET NO. 1

ASSIGNMENTS: LESSON 15

PRACTICAL WORK IN USE OF THE COMPASS

The navigator who maintains a continuous plot, knows with a fair degree of certainty not only his position at any time but also how far he has traveled and what course he would have to steer in the event his plans must be changed. If he must make port unexpectedly due to weather or illness, a quick calculation will give him the needed information. If he meets with an accident, he can report his position quickly.

The navigator must practice constantly in the art of keeping an accurate, up to the minute plot.

1. A ship is at latitude 28° 30' N, Long 91° 25' W; variation is 7° 30' E; deviation is 2° E on 090° T, 4° E on 180° T, 1° E on 270° T and 3° W on 000° T: ship steams at 10 knots for 4 hours on course 045° (compass). Changes to course 120° T and steams for 6 hours. What is position?
2. What compass course would have to be steered to return to point of origin?
3. How long would the return take?
4. Find the reciprocal courses in each case above.

APPENDIX A

This course is written in the language of the seaman. The following list will be helpful references.

COMMON NAUTICAL TERMS

ABAFT: Toward the stern of a vessel. AFT, AFTER, located near the stern.

ABEAM: At the right angles to the fore and aft line of a vessel.

ABOARD: On, or in a vessel, on board.

ABOUT: To turn around, or in sailing vessels to come ABOUT is to go on the opposite tack.

ABREAST: Along side of, as two vessels are running side by side.

ACCOMMODATION: Quarters or compartments for crew or passengers.

ADRIFT: Unmoored, floating with wind and tide.

AGROUND: Touching bottom.

ALEE: The sheltered side, the side of a vessel away from the wind. Opposed to AWEATHER.

ALOFT: In the rigging, any place above deck, as the CROW'S NEST is ALOFT.

ASTERN: Behind, any point off the stern of a vessel, as a net is towed astern.

ATHWART: Across, transverse, at right angles to the fore and aft line.

ATHWARTSHIP: Across, at right angles to the keel.

AWEIGHT: Said of an anchor when it is just broken out of the bottom.

BAROMETER: A device that indicates the pressure to the atmosphere, used to forecast weather.

BEARING: The direction from a vessel to a distant object.

BELAY: To make fast a line by turns around a BELAYING PIN or cleat without hitching or seizing it, also to stop, as BELAY that order

APPENDIX A

COMMON NAUTICAL TERMS (Contd.)

BERTH: Mooring space for a vessel; a bunk or cot for a person.

BOW: The forward part of the vessel, the part where the sides trend inward to the stem. ON THE BOW, OFF THE BOW are terms of relative direction as the lighthouse is two points OFF THE STARBOARD BOW.

BOX THE COMPASS: To name the thirty-two points of the compass from North through East on around back to North. Also said of the wind when it shifts direction all around the compass.

BROACH-TO: To be turned at right angles to a following sea.

BY: Near to or toward, as a vessel is DOWN by the stern when she is carrying a load aft and is light forward.

CAPSIZE: To upset or overturn.

CARDINAL: Fundamental, main, as the CARDINAL points of the compass are the four main points, North, South, East and West.

CAULK OR CALK: To drive cotton or other fibers between the planks or in the seams on deck.

DAVY JONES: The Spirit of the sea; the devil. Davy Jones' locker is the bottom of the sea.

CELESTIAL NAVIGATION: The practice of navigating by the stars, that is determining a vessel's position by measuring altitudes of stars with a sextant.

CHRONOMETER: A very accurate watch or clock used to keep time aboard ship for navigational purposes.

DEAD RECKONING: The practice of estimating a vessels position by considering courses and distances made since departure from known positions.

DERELICT: A vessel abandoned or forsaken on the high seas.

DISPLACEMENT: The volume or weight of water displaced by a vessel, such weight is exactly equal to the total weight of the vessel when hauled out.

DRAFT: The depth a vessel sinks into the water as measured from waterline to lowest part of hull or keel; the depth of water required to float a vessel.

FLARE: The outward spreading of a vessels bow, the increase of width of the bows from the waterline upward to the deck.

APPENDIX A

COMMON NAUTICAL TERMS (Contd.)

FLOATSAM: The litter or wreckage of a lost vessel floating in the sea. Debris on the water

FORE AND AFT: Along the length of the vessel.

FOUL: Entangled, kinked as with ropes. Not clear, unfavorable as with conditions of weather.

FOUNDER: To sink by filling with water as distinguished from sinking by CAPSIZING.

GALLEY: The kitchen, the area or compartment containing the cooking facilities.

HEEL: To lay over, to lean as a vessel HEELS with the wind.

JACOB'S LADDER: A rope ladder with wooden steps.

KNOT: A measure of speed equal to one nautical mile (6,080 ft.) per hour. One KNOT is equal to 6080/5280 or approximately one and one eighth mile per hour.

LEAGUE: A measure of distances, now rarely used, equal to three nautical miles.

LEE: The side away from the wind. Opposite WEATHER.

LOG: A device for measuring distance traveled at sea, also a record book such as a radio log or "THE SHIP'S LOG".

LUBBER LINE: The fore and aft line of the compass.

PILOTING: Conducting a vessel along the coast or in harbors and rivers where buoys, landmarks, etc. can be used to determine position.

SEXTANT: An instrument used at sea to measure angles from ship to the horizon and a star. Also used to measure horizontal angles such as angle at vessel between two buoys.

SOUND: To measure the depth of water. SOUNDINGS are the depth indicated on the chart.

SPIN-DRIFT: Water swept off the top of waves by strong wind.

STARBOARD: The right side of a vessel when facing forward. THE PORT side is the left side.

TOPSIDE: On or above the weather deck.

WEATHER: The side toward the wind. (Exposed)

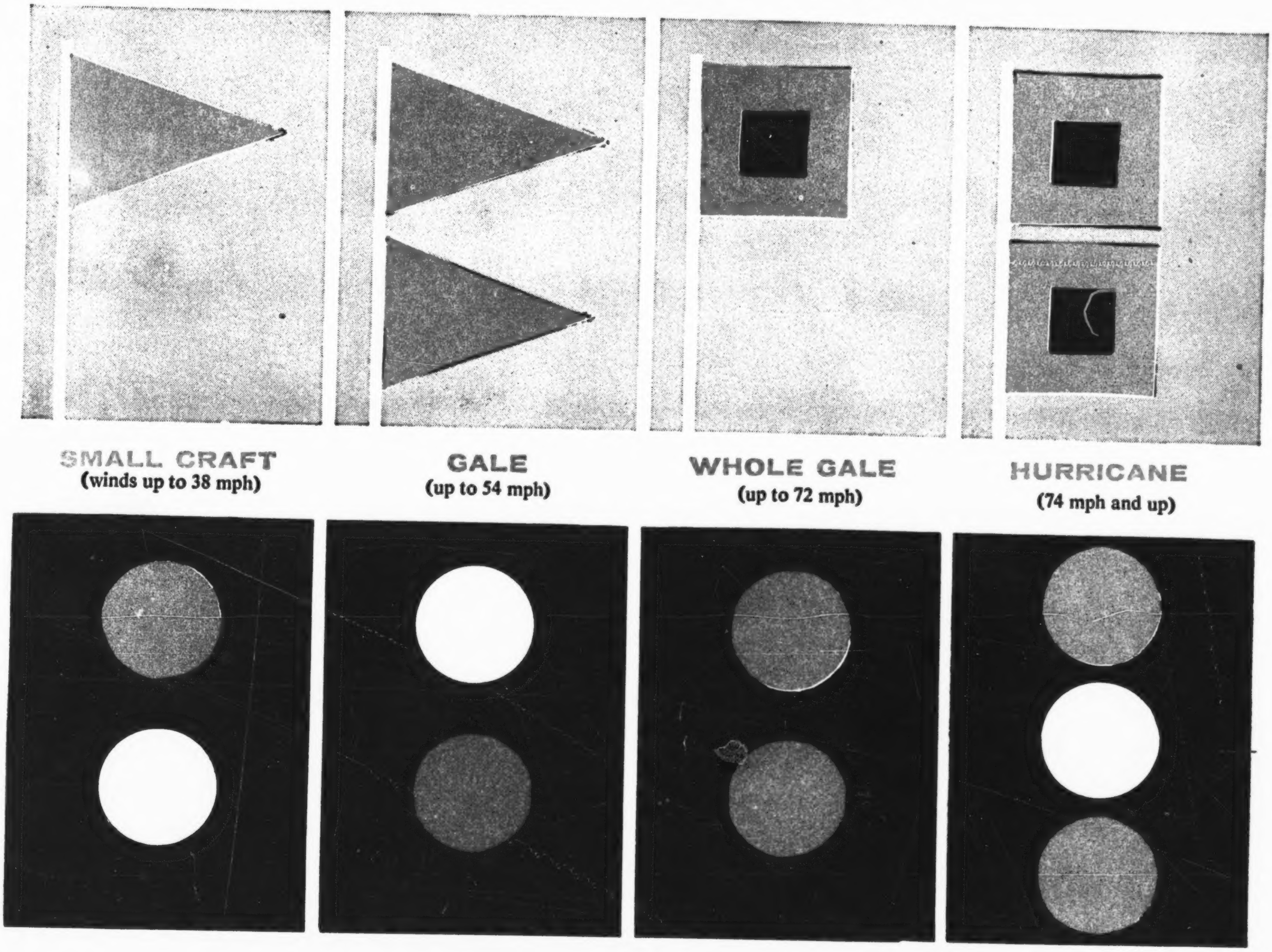
APPENDIX B

EQUIPMENT REQUIRED ON MOTOR BOATS TABLE ONE

EQUIPMENT	CLASS A LESS THAN 16 FT.	CLASS 1 16 FT.-UNDER 26 FT.	CLASS 2 26 FT.-UNDER 40 FT.	CLASS 3 40 FT-NOT OVER 65 FT
BOW LIGHT	NONE	NONE	20 PT. WHITE LIGHT FORWARD	
SIDE LIGHTS	COMBINATION RED(PORT) & GREEN ST'B'D)		10 PT. RED (PORT) & 10 PT. GREEN (ST'B'D)	
STERN LIGHT	32 PT. WHITE LIGHT AFT-HIGHER THAN F'WD WHITE LIGHT			
WHISTLE	NONE	MOUTH OR HAND OPERATED		POWER OPERATED
BELL	NONE	NONE	REQ'D.	REQ'D.
LIFESAVING DEVICES	ONE APPROVED LIFE PRESERVER, VEST, OR RING BUOY PER PERSON			APP.JACKETS ONLY
FLAME ARRESTOR REQ'D ON CARBURETORS OF ALL GASOLINE ENGINES EXCEPT OUTBOARDS				
AT LEAST TWO VENTS REQ'D IN ENGINE RM. & TANK COMP'T OF GASOLINE POWERED BOATS				
FIRE EXTINGUISHERS	ONE	ONE	TWO	THREE
NOTE-SEE "MOTORBOAT REGULATION" - CG-168 FOR COMPLETE EQUIPMENT REQUIREMENTS				

APPENDIX C

How safe a skipper are you?



Know the new storm warnings

APPENDIX D

INTRODUCTION TO FIRST AID

FOR LESSONS 1, 2, & 3

First Aid is considered by the writers of this guide to be important enough to merit some comment. In an occupational situation such as off shore fishing, at one time or another some injury or acute sickness may occur which will require first aid on the part of crew members in fishing type vessels. If the vessel is to be operated in a safe manner and in consideration of the health, safety, and comfort of crew members, then first aid must be given consideration.

First Aid is defined as immediate and temporary care given to the victims of an accident or acute illness and continued until such time as the victim can be turned over to a competent medical facility, such as, a mobile unit with a doctor in charge or a hospital. This definition indicated that first, first aid should be administered by anyone at the scene of the accident or acute illness; second, since first aid is immediate by definition then all persons who may be on the scene of an accident should have some knowledge of first aid practices; and third, since accidents and acute illness may strike at any time and under any circumstances any of us should be prepared to render first aid.

First Aid is more than a bandage or dressing. Usually the victim's main problem is shock and anxiety. The one administering first aid can make his best contribution by assisting the accident or illness victim in accepting his condition. That is to say an accident victim needs to feel that he is receiving care and attention. If the first aid is administered calmly and confidently then the victim will feel this security. An understanding of injuries and illness is necessary for proper first aid. The person administering first aid must first understand that the victim depends upon him actually and emotionally, so he can perform his best function by giving the victim this sense of security.

In undertaking a study of first aid the student should first study people in terms of their physical requirements. He must understand the functions of the human body. Secondly the student must study injuries as they might occur, such as, cuts, burns, and broken bones, and the student must become familiar with acute illness with their symtoms and proper immediate care, finally the student should know what to carry in terms of first aid equipment on a boat or into any situation where medical help may be hard to come by. At sea the sailor is particularly concerned because sometimes a day or two may elapse between an accident and the time when the victim can be placed in a hospital under a doctors care.

The first big advantage of first aid training is to the student himself. By having this training he really helps himself in several ways. First he learns how to care for his own injuries, if he is injured and alone he may be able to help himself quite a bit if he knows first aid, if he is with others and too badly hurt to help himself he may be able to direct others in caring for his needs, also, the student by having first aid training will develop safety conscienceness because he realizes the dangers of accidents and understands their seriousness. It is a fact, that people trained in first aid generally do not have as many accidents as those people who are ignorant of first aid procedures. Finally of course, first aid training gives the student confidence in his ability to assist others. No matter who we are whether we admit it or not, we enjoy being able to help other people when they need us.

ASSIGNMENTS: FIRST AID (Lessons 1, 2, & 3)

I. Define first aid. Write out your definition.

II. Describe the symptoms of shock.

III. List in order of importance the procedures for treating shock.

IV. Demonstrate two methods of artificial respiration.

V. List accidents which may cause stoppage of breathing.

VI. Demonstrate the control of bleeding in different types of wounds in different parts of the body.

VII. Distinguish between arterial and veinous bleeding.

VIII. How should burns be handled?

  a. First degree.

  b. Second degree.

  c. Third degree.

IX. Why is treatment for shock so important?